
CMA Part 1

Financial Planning, Performance and Control

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Fifth Edition
CMA
Preparatory Program

Part 1

**Financial Planning,
Performance and Control**

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Editorial Notes

Throughout these materials, we have chosen particular language, spellings, structures and grammar in order to be consistent and comprehensible for all readers. HOCK study materials are used by candidates from countries throughout the world, and for many, English is a second language. We are aware that our choices may not always adhere to “formal” standards, but our efforts are focused on making the study process easy for all of our candidates. Nonetheless, we continue to welcome your meaningful corrections and ideas for creating better materials.

This material is designed exclusively to assist people in their exam preparation. No information in the material should be construed as authoritative business, accounting or consulting advice. Appropriate professionals should be consulted for such advice and consulting.

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Welcome to HOCK *international*! You have made a wonderful commitment to yourself and your profession by choosing to pursue this prestigious credential. The process of certification is an important one that demonstrates your skills, knowledge and commitment to your work.

We are honored that you have chosen HOCK as your partner in this process. We know that this is a great responsibility, and it is our goal to make this process as painless and efficient as possible for you. To do so, HOCK has developed the following tools for your use:

- **A Study Plan** that guides you, week by week, through the study process. You can also create a personalized study plan online to adapt the plan to fit your schedule. Your personalized plan can also be emailed to you at the beginning of each week.
- **The Textbook** that you are currently reading. This is your main study source and contains all of the information necessary to pass the exam. This textbook follows the exam contents and provides all necessary background information so that you don't need to purchase or read other books.
- **The Flash Cards** include short summaries of main topics, key formulas and concepts. You can use them to review whenever you have a few minutes, but don't want to take your textbook along.
- **ExamSuccess** contains original questions and questions from past exams that are relevant to the current syllabus. Answer explanations for the correct and incorrect answers are also included for each question.
- **Practice Questions** taken from past CMA Exams that provide the opportunity to practice the essay-style questions on the Exam.
- **Teacher Support** via our online student forum, e-mail, and telephone throughout your studies to answer any questions that may arise.
- **Class Recordings** are audio recordings of classes conducted and taught by HOCK lecturers. With the Class Recordings you are able to have the benefits of attending classes without actually being required to be near a location where classes are held.

We understand the commitment that you have made to the exams, and we will match that commitment in our efforts to help you. Furthermore, we understand that your time is too valuable to study for an exam twice, so we will do everything possible to make sure that you pass the first time.

I wish you success in your studies, and if there is anything I can do to assist you, please contact me directly at brian.hock@hockinternational.com.

Sincerely,

Brian Hock, CMA, CIA
President and CEO

Table of Contents

Introduction to CMA Part 1	1
Section A – Planning, Budgeting and Forecasting.....	3
Planning and Budgeting Concepts	4
Planning in Order to Achieve Superior Performance	4
The Role of Management in Attaining Profitable Growth	4
The External Environment in Planning and Budgeting	5
Setting Objectives and Goals	6
Types of Plans and General Principles	7
Budgeting	10
The Relationship Among Planning, Budgeting and Performance Evaluation	10
Advantages of Budgets	12
Characteristics of Successful Budgeting	13
Time Frames for Budgets	14
Who Should Participate in the Budgeting Process	14
The Budget Development Process	15
Best Practice Guidelines for the Budget Process	16
Budgetary Slack and Its Impact on Goal Congruence	17
Responsibility Centers and Controllable Costs	17
Cost Standards in Budgeting	18
Setting Standard Costs	19
The Standard-Setting Process	20
Budget Methodologies	23
Annual/Master Budget	23
The Different Budgets	24
The Sales Budget	24
The Production Budget	25
Direct Labor Budget	25
Cost of Goods Sold Budget	26
Other Budgets	26
The Cash Budget	27
The Operating and Financial Budgets	27
The Capital Expenditures Budget	28
The Master Budget	28
Flexible Budgets	29
Other Types of Budgets	31
Project Budgeting	31
Activity-Based Budgeting	32
Zero-Base Budgeting	32

Continuous (Rolling) Budgets	33
Budget Reports	33
Budgeting Questions	34
Flexible Budgeting Questions	34
Units to Produce / Purchase Questions	36
Cash Flow Questions	40
Forecasting Techniques	42
Forecasting and Budgeting	42
Collecting the Data for a Forecast	42
Time Series Analysis	42
Using Time Series Analysis in Forecasting	44
Inflation Adjustment in a Time Series Analysis	52
Causal Forecasting	56
Benefits and Limitations of Regression Analysis	60
Learning Curves	62
Cumulative Average vs. Incremental Unit Model	62
Cumulative Average-Time Learning Model	62
Incremental Unit-Time Learning Model	64
Benefits of Learning Curve Analysis	66
Limitations of Learning Curve Analysis	66
Probability	68
Two Requirements of Probability	68
Conditional Probability	68
Joint Probability	68
Three Methods of Assigning Probable Values	69
Discrete and Continuous Random Variables	70
Discrete Random Variable Probability Distributions	71
Expected Value	72
Variance and Standard Deviation	73
Continuous Random Variable Probability Distributions	74
Normal Probability Distribution	74
Risk, Uncertainty and Expected Value	76
The Mean, Median and Mode	77
Expected Value in Estimating Future Cash Flows	77
Statistical Measurements of Cash Flow Variability	77
Summary of Probability and Expected Value	80
Sensitivity Analysis	83
Top-Level Planning and Analysis	84
Pro Forma Financial Statements	84
Forecasting for Planning	85
Sales Forecasting	85

Forecasting Future Financing Needs	86
Analysis of Pro Forma Financial Statements	95
Other Uses of Pro Forma Financial Statements	97
Section B – Performance Management	98
Introduction to Variance Analysis and Standard Costs	99
Determining the Level of Activity	100
Sources of Standards	100
Management by Exception	101
Variance Analysis Concepts.....	102
Static Budget Variances Vs Flexible Budget Variances	102
Static Budget Variances	102
Flexible Budget Variances and Sales Volume Variances	104
Types of Variances	105
Manufacturing Input Variances	106
Direct Materials Variances	108
The Quantity Variance	108
The Price Variance	109
Purchase Price Variance	109
Accounting for Direct Materials Variances in a Standard Cost System	110
Direct Labor Variances	112
The Labor Rate Variance	112
The Labor Efficiency Variance	112
Accounting for Direct Labor Variances in a Standard Cost System	112
More than One Material Input or One Labor Class	115
Total Variance of a Weighted Mix	115
Materials Price Variance or Labor Rate Variance of a Weighted Mix	115
Total Material Quantity or Labor Efficiency Variance of a Weighted Mix	115
Factory Overhead Variances	120
Variable Overhead Variances	120
Fixed Overhead Variances	122
Two-Way, Three-Way and Four-Way Analysis	126
Summary Table of Variance Calculations	128
Sales Variances	129
Sales Variances for a Single Product Firm	132
Sales Price Variance for a Single Product Firm (Flexible Budget Variance)	132
Sales Volume Variance for a Single Product Firm	133
Sales Variances When MORE THAN ONE Product is Sold	134
Sales Price Variance (Flexible Budget Variance) for a Multi-Product Firm	137
Sales Volume Variances for a Multi-Product Firm	138
Sales Quantity Variance for a Multi-Product Firm	139

Sales Mix Variance for a Multi-Product Firm	139
Total Sales Variance for a Multi-Product Firm	140
Variances Example Using Contribution Margin	141
Market Variances	145
Variance Analysis for a Service Company	146
Responsibility Centers and Reporting Segments	147
Allocation of Common Costs	149
The Contribution Income Statement Approach to Evaluation	152
Use of the Contribution Income Statement	153
Transfer Pricing	155
Transfer Pricing Objectives	155
Transfer Pricing Methods	156
Performance Measures	162
Strategic Issues in Performance Measurement	162
Timing of Feedback	162
Performance Measurement	162
Return-on-Investment (ROI)	163
Residual Income (RI)	169
Using These Measures	172
Performance Measurement in Multinational Companies	173
Multiple Measures of Performance and the Balanced Scorecard	175
Customer and Product Profitability Analysis	178
Section C – Cost Management	179
Classifications of Costs	180
Costs Based on Level of Production	180
Production vs. Period Costs	182
Types of Product Costs	182
Other Costs and Cost Classifications	184
Cost of Goods Sold (COGS) and Cost of Goods Manufactured (COGM)	186
Variable and Absorption Costing	188
Fixed Factory Overheads Under Variable Costing	188
Fixed Factory Overheads Under Absorption Costing	188
Effects of Changing Inventory Levels	189
Income Statement Presentation	190
The Income Statement under Absorption Costing	190
The Income Statement under Variable (Direct) Costing	190
Answer to the Variable/Absorption Costing Example	193
Joint Products and Byproducts	198
Joint Products	198

Byproducts	201
Process Costing	204
Steps in Process Costing	205
1. Determine the Physical Flow of Goods	205
2. Calculate the Number of Units Started and Completed	206
3. Determine When the Materials Are Added to the Process	206
4. Calculate the Equivalent Units of Production (EUP)	206
5. Calculation of Costs Incurred During the Period	212
6. Calculation of the Cost per EUP	212
7. Allocation of the Costs to the Products	212
Process Costing Diagram – FIFO	213
Process Costing Diagram – Weighted Average	214
Process Costing Summary	215
Process Costing Examples	216
Spoilage in Process Costing	221
EUP for Spoilage for Conversion Costs	221
EUP for Spoilage for Materials	221
Allocation of Costs to the Spoiled Units	221
Transferring the Costs of Spoiled Units	221
Normal Spoilage	222
Abnormal Spoilage	222
Additional Classifications of Spoilage	222
Overhead Allocation	226
Manufacturing Overhead Allocation	226
Standard (Traditional) Allocation Method	227
Determining the Basis of Allocation	227
Calculating the Manufacturing Overhead Allocation Rate	228
Determining the Level of Activity	229
Allocating Manufacturing Overhead to the Units	230
Costing System Methods	231
The Process of Accounting for Factory Overhead	233
Over-Applied and Under-Applied Manufacturing Overhead	234
Comprehensive Example of Accounting for Fixed Overhead and FOH Variances	235
Activity-Based Costing	239
Job-Order Costing	247
Life-Cycle Costing	248
Service Cost Allocation.....	250
Allocating Costs of One Service or Support Department to Multiple Users	250
Allocating Costs of Multiple Service or Support Departments	253
The Direct Method	254
The Step Method	254

The Reciprocal Method	255
Comprehensive Example of Direct, Step and Reciprocal Methods	255
Estimating Fixed Costs	258
High-Low Points Method	258
Regression Analysis	260
Operational Efficiency	263
Just-in-Time (JIT) Inventory Management Systems	263
Kanban	264
Materials Requirements or Material Resource Planning (MRP)	265
MRP and Making Calculations in Manufacturing	266
Outsourcing	268
Theory of Constraints (TOC)	268
Calculating Throughput Contribution Margin	272
Capacity Level and Management Decisions	273
Capacity Level and Financial Statements	274
Business Process Performance	276
The Value Chain	276
Primary Value Chain Activities	277
Steps in Value Chain Analysis	277
Business Process Reengineering	278
Benchmarking Process Performance	279
Activity-Based Management (ABM)	280
The Concept of <i>Kaizen</i>	280
The Costs of Quality	281
Total Quality Management (TQM)	283
Total Quality Management and Activity-Based Management	285
ISO 9000	285
Quality Management and Productivity	285
Other Quality Related Issues	286
Section D – Internal Controls	289
Risk Assessment, Controls and Risk Management	291
Internal Control Definition and Objectives	291
Who Is Responsible for Internal Control?	293
Components of Internal Control	294
Component 1: The Control Environment	294
Component 2: Risk Assessment	296
Component 3: Control Activities	298
Component 4: Information and Communication	301
Component 5: Monitoring	302
Segregation of Duties	303

Responsibilities of the Board of Directors	305
Audit Committee Requirements, Responsibilities and Authority	306
Requirements for Audit Committee and Audit Committee members:	306
Responsibilities of the Audit Committee:	307
Authority of the Audit Committee:	308
Legislative Initiatives on Internal Control	308
Foreign Corrupt Practices Act (FCPA)	309
Sarbanes-Oxley Act	310
Public Company Accounting Oversight Board (PCAOB)	310
Major Internal Control Provisions of Sarbanes-Oxley	311
PCAOB Preferred Approach to Auditing Internal Controls in Auditing Standard No. 5	313
PCAOB Auditing Standard 5: Steps to a Top-Down Approach	315
SEC Release 33-8810	317
Top-Down Approach Versus Bottom-Up Approach	320
What Internal Control Can and Cannot Do	321
Internal Auditing	322
Definition of Internal Auditing	322
Responsibilities of the Internal Auditing Function	323
The Difference Between Internal Auditors and External Auditors	325
Coordination of Work Between Internal and External Auditors	326
Types of Engagements	327
Assurance Services	327
Consulting Services	329
The Auditing Process	330
Determining Which Engagements to Conduct	330
Planning the Audit	331
Understanding Internal Controls in the Planning of the Audit	335
The Internal Audit Program	337
Audit Evidence	339
Audits of Financial Controls	343
Types of Controls	343
Accounting Controls Versus Administrative Controls	344
Objectives of an Audit of Controls	344
Testing Compliance with Controls	344
Control Breakdowns	345
Detection and Prevention of Fraud	346
Consideration of Fraud in the Planning of a Financial Statement Audit	347
Internal Audit Reports	348
Oral Reports and Interim Reports	349
Preparing the Final Written Internal Audit Report	349
Contents of the Final Report	349
Summary Reports	352

Report Review and Distribution	352
Types of Incidents That Should Be Reported	353
Auditor Follow-Up	353
Computerized Audit Techniques	354
Systems Controls and Security Measures	357
Introduction to Systems Controls	357
Threats to Information Systems	358
The Classification of Controls	359
General Controls	360
Organization and operation of the computer facilities	360
General Operating Procedures	361
Equipment Controls	361
Equipment Access and Data Access Controls	361
Segregation of Duties	362
System and Program Development and Change Controls	364
Physical Access Controls	370
Hardware Controls for Networks	370
File Security and Storage Controls	371
Application Controls	372
Input Controls	372
Processing Controls	375
Output Controls	377
Controls Classified as Preventive, Detective and Corrective	378
Internet Security	379
Viruses, Trojan Horses and Worms	380
Cybercrime	381
Defenses Against Cybercrime	383
Encryption	384
Contingency Planning.....	385
Disaster Recovery	386
 Section E – Professional Ethics	 388
Introduction to Ethics	388
Business Ethics	388
Ethical Behavior for Practitioners of Management Accounting and Financial Management...	390
Statement of Ethical Professional Practice	390
 Answers to Questions.....	 395

Introduction to CMA Part 1

The Part 1 Exam has five sections included in the Learning Outcome Statements. The five sections and their approximate weights on the exam are:

- 1) Planning, Budgeting and Forecasting: 30%
- 2) Performance Management: 25%
- 3) Cost Management: 25%
- 4) Internal Controls: 15%
- 5) Professional Ethics: 5%

The Learning Outcome Statements (LOS) for all Parts are available to download on our web site.

Section A, **Planning, Budgeting and Forecasting**, represents 30% of the exam, which is the largest part of the exam in terms of weight. Planning, budgeting and forecasting are very important skills for the CMA, and this section should be one of the areas you focus on in your preparation.

Section B, **Performance Management**, is 25% of the exam, another large part. Section B covers variance analysis and responsibility accounting as well as financial performance measures. For variances you need to be able to both calculate the variances and interpret the information that you get through variance analysis. This will require the memorization of the variance formulas, but also an understanding of what each formula is calculating.

Section C, **Cost Management**, is also 25% of the exam. This section focuses on variable and absorption costing and covers a number of methods of allocating costs and overheads. You will need to be familiar with all of them. It also covers business process performance and quality issues.

Section D, **Internal Controls**, represents 15% of the exam. That does not mean you can ignore it, though. The technicalities of internal controls are important to know, especially the relevant laws that businesses are subject to and the related guidance that has been published. The Sarbanes-Oxley Act has had effects that are far reaching, and you should be familiar with its requirements.

Section E, **Professional Ethics**, is only 5% of the exam. However, ethics could be integrated with any other topic on the exam, so ethics questions are not limited to just one section of the exam.

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Section A – Planning, Budgeting and Forecasting

Planning, Budgeting and Forecasting represents 30% of the CMA Part 1 exam. Part 1 is a four hour exam that will contain 100 multiple-choice questions and 2 essay questions. Topics within an examination part and the subject areas within topics may be combined in individual questions. Therefore, we cannot predict how many multiple choice questions you may get from this section, nor can we predict whether you will get any essay questions from this section. The best approach to preparing for this exam is to know and understand the concepts well and be ready for anything.

This section focuses on the budgeting process in a business and its inseparable connection with the planning process. Exam questions may address the theories and process of planning and budgeting as well as the different types of planning and budgeting. Top-level planning and the use of pro forma financial statements in the planning process are important topics.

Numerical questions may relate to how much should be budgeted or expected during a period. Questions may also involve a more detailed calculation of the expected cash balance at some period in time, or the cash inflows or outflows during a period. The scope of the numerical questions in planning and budgeting is large, requiring the ability to apply principles and ideas to different situations.

The topics of strategic and other types of planning are not specifically included in the Learning Outcome Statements for this exam. However, we have included a brief discussion of planning here because of its foundational importance in budgeting. You need to understand the benefits of planning, the goals of planning and the general steps in the planning process. Additionally, you should be familiar with the different types of planning that a business does.

In the area of budgeting, you must understand the budget process and the order in which the different budgets are prepared. You also must be able to make different budgeting calculations. These calculations are not necessarily intuitive when you begin your study process, but after doing some questions and memorizing the required formulas, this should become an area where you will feel very comfortable.

Forecasting techniques, learning curves and other quantitative analysis tools are included because of their usefulness in planning and budgeting. Another topic in this section, top-level planning and analysis, deals with pro forma financial statements and their use in strategic planning.

Planning and Budgeting Concepts

We are all familiar with budgets in at least an informal manner. We often see them at work or are impacted by them when something can't be done because it is "not in the budget." The budget is developed in advance of the period that it covers, and it is based on forecasts and assumptions. But the budget is not something that is primarily for the purpose of restricting what can be done. It is intended as a planning tool and a guideline to follow in order to achieve the company's planned goals and objectives.

The budgeting process is inseparably linked to the planning process in an organization. Major planning decisions by management are required before the budget can be developed for the coming period. Furthermore, the development of the budget may cause previously developed short-term plans by management to require adjustment. As the projected quantitative results of the plans become clear in the developing budget, management may need to revise its plans. And after the plans and the budget have been adopted, as the period unfolds, the budget provides control and feedback.

In this section we will look at the different types of planning and budgets and how the planning and budgeting process within a company works. We will also examine the reports that come about as a result of the budget along with the different types of budgets that may be prepared.

Planning in Order to Achieve Superior Performance

All business endeavors must have objectives and goals. For most companies, if not all, the ultimate objective is to achieve **superior performance** in comparison with the performance of their competitors. When superior performance is achieved, company profitability will increase. When profits are growing, shareholder value will grow. A publicly-owned for-profit company must have maximizing shareholder value as its ultimate goal. The shareholders are the owners. They have provided risk capital with the expectation that the managers will pursue strategies that will give them a good return on their investment. Thus, managers have an obligation to invest company profits in such a way that shareholder value will be maximized.

Shareholders want to see **profitable growth**: high profitability and also sustainable profit growth. A company with profits but whose profits are not growing will be not be valued as highly by shareholders as a company with profitability **and** profit growth. Attaining and maintaining both profitability and profit growth is one of the greatest challenges facing managers.

The Role of Management in Attaining Profitable Growth

There are two opposing philosophies with respect to the role of management.

- The **market theory** gives management a passive role and views its function basically as making reactive decisions to respond to environmental events as they occur.
- The **planning and control theory** views the role of management as an active one that emphasizes the planning function of management and its ability to control the activities of the business.

Most companies' managements operate somewhere between these two extremes. At times, events will occur that are outside the control of management and may even be important enough to determine the firm's destiny. But in almost all of these situations, when noncontrollable variables become dominant, a competent management can manipulate the situation to move the company to environments where the variables are controllable again.

When management operates more closely to the planning and control theory, it has more ability to reduce the randomness of events and to deal productively with those that do occur.

The External Environment in Planning and Budgeting

Planning does not occur in a vacuum. A business must interact with its external environment, and this environment includes influences that will impact the plans that management makes. These external events will impact not only the company's plans but also its budget. Although past financial results and information may be used in developing the budget for the next period, the budget is still a documented expression of what the company would like to accomplish financially in **future periods**. For instance, sales in the current year-to-date may have been impacted by the economy or an internal situation that has changed. The past is not a predictor of the future, and the plan and the resulting budget should reflect the conditions anticipated for the coming period, not the conditions that existed in the past period or periods.

Three interrelated environments affect management's planning and budgeting:

- The **industry** in which the company operates,
- The **country** or the **national environment** in which the company operates,
- And the wider **macroenvironment** in which the company operates.

An **industry** analysis involves assessing the company's industry as a whole, the company's competitive position in the industry, and the competitive positions of its major rivals. The nature of the industry, the stage the industry is in, the dynamics and the history are all part of this analysis. For example, the industry the company operates in may be highly competitive, or it may be less competitive. The amount of competition the company faces will impact the prices it can charge, the marketing effort needed, research and development needs, and so forth. Likewise, if the industry is growing, the company can expect and plan to benefit from that growth; or, if the industry is in a decline, the company should plan how it needs to respond to that.

Analyzing the **national and international environment** includes assessing domestic as well as international political risk and the impact of globalization on competition within the industry. International political risks include the obvious risks of government **expropriation** (government seizure of private property with some minimal compensation offered which is generally not an adequate amount); and **war** (which can affect employee safety and create additional costs to ensure employees' safety).

The **macroenvironment** includes macroeconomic factors that will effect the entire industry or economy as a whole. The most important macroeconomic factors in planning and budgeting are **(1)** the growth rate of the economy, **(2)** interest rates, **(3)** currency exchange rates, and **(4)** inflation or deflation rates.

- **Economic growth** leads to more consumer spending and gives companies the opportunity to expand their operations and increase their profits. Economic recession leads to a reduction in consumer spending and, in a mature industry, may cause price wars. Both will affect demand and thus sales revenue and net income in the future.
- The **level of interest rates** can affect a company's sales and net income if the company is in an industry where demand is affected by interest rates, such as the housing market or the manufacture of capital goods. Rising interest rates will cause demand to decrease, while falling interest rates will cause demand to increase. Interest rates also affect any company's cost of capital and thus its ability to raise capital and invest.
- **Changes in currency exchange rates** affect the competitiveness of companies in international trade. A declining U.S. dollar creates opportunities for increased international sales while at the same time, it decreases foreign competition. An increasing U.S. dollar causes the opposite condition.
- Both **Inflation and deflation** cause businesses to be less willing to make investments in new projects. When inflation increases, it is difficult to plan on what the real return will be from an investment. Deflation also causes a lack of stability in the economy, because when prices are deflating, companies with a high level of debt and the obligation to make regular fixed payments on the debt can find themselves unable to service that debt. So those companies will be reluctant to commit to new investment projects.

The macroenvironment also includes **social factors** such as environmental issues and government, legal, international and technological factors that affect the industry and the company. A couple of the many possible examples are:

- The extent to which environmental protection laws are enforced by the Environmental Protection Agency or new ones passed by Congress depends to a great degree upon the position of the administration in charge at any given time, since the President of the United States appoints the head of the EPA.
- Current or future anticipated tax credits can affect an entire industry by creating demand. A present example is tax credits for installation of solar electricity-generating panels. Companies affected will include firms that manufacture the materials used by solar panel manufacturers, the manufacturers of the solar panels, and the companies that install them.

Setting Objectives and Goals

One of the most basic and important outcomes of the planning process is the development of the company's objectives and goals. The identification of the company's objectives is the first step in the planning process. Even if the plan relates to a small business project, all of the project participants must be aware of and understand what is supposed to be accomplished by this project – the goal of the project – before it can be developed.

Unfortunately, a company may have a number of different objectives, and in a worst-case scenario, some of these may be contradictory to each other. It is up to management to **prioritize the company's objectives** and then communicate these priorities to the people within the organization. Without the communication of the plan and its objectives, planning is a useless process for the company.

The objectives that are developed must be **clearly stated in specific terms**. This prevents 'interpretation' of the objectives by employees.

Additionally, objectives must be **communicated to all individuals that they will impact**. A formal way of communicating the organization's objectives is through its **mission statement**. In many companies the mission statement is very prominently displayed and constitutes a large part of the corporate culture. In any case, the goals and objectives of the company, department or project need to be communicated to the people impacted by them.

Finally, for any objective to be effective, individuals within the organization must **accept** the objectives. Though it is not possible for everyone in the organization to agree with every objective, it is essential that the objectives are clearly understood and communicated, allowing people to address whatever concerns they have about the goals. However, after this is done, all of the employees need to work toward the goals of the company.

A **goal** is similar to an objective, but different in that goals are developed and implemented at the unit or department level while objectives are at the organizational, or enterprise, level. In a sense it is through the accomplishment of the goals of the division that the objectives of the organization are met.

Planning is the process that enables a company to achieve its goals and objectives. As stated before, a company may have many objectives throughout the organization. It is the responsibility of management to make sure that all of the smaller goals and objectives work toward the ultimate achievement of the company's main objectives. Management must make certain that this harmonization of goals is done as efficiently and effectively as possible.

Note: Because people in each department are most closely connected with the goals of their own department, there is the risk that the employees will develop **tunnel vision**. Tunnel vision occurs when employees become so concerned with their own goals, they fail to notice or care about the larger objectives of the company. If in doing your job you prevent others from doing their jobs, the company not only does not benefit, but it can actually be hurt.

Two terms that are related to the accomplishments of goals and objectives are efficiency and effectiveness. **Efficiency** is the attempt to fulfill the objectives of the company while using the least amount of inputs. On the other hand, **effectiveness** has to do with the actual accomplishment of goals. Though both of these are important, in reality it is obvious that effectiveness is of ultimate importance. If a company is efficient but does not accomplish what is needed, then the efforts and resources used were wasted.

When the objectives of one level of the company dovetail (are in agreement with each other) with the objectives of the next highest level, the company has achieved a **means-end relationship**. This results when the achievement of the objectives of one level enables the next highest level to achieve its objectives as well.

Note: No matter how important planning is to an organization or how developed its methodology, the planning process will never replace the control process. Both are necessary.

Question 1: Which of the following is not a significant reason for planning in an organization?

- a) Promoting coordination among operating units.
- b) Forcing managers to consider expected future trends and conditions.
- c) Developing a basis for controlling operations.
- d) Monitoring of profitable operations.

(CMA Adapted)

Types of Plans and General Principles

In order for plans to be as effective as possible, they must be coordinated among the different units and departments in the company so that they are in alignment with the larger goals of the company. If this is not the case, different parts of the company may be working at cross-purposes and the company will not move in a positive direction.

Strategic Plans (Long-Term Plans)

Planning is done initially on a long-term basis, called strategic planning. Strategic plans are broad, general, long-term plans (usually five years or longer) and are based on the objectives of the organization. Strategic planning is done by the company's top management.

This type of planning is neither detailed nor focused on specific financial targets, but instead looks at the **strategies, objectives and goals of the company** by examining both the **internal and external factors** affecting the company. Internal factors include current facilities, current products and market share, corporate goals and objectives, long-term targets, technology investment, and anything else in the direct control of the company itself.

As already mentioned, external factors also need to be taken into account in strategic planning. Some of the external factors are the economy, labor market, domestic and international competition, environmental issues, technological developments, developing new markets, and political risk in other countries (or the home country).

This process of reviewing the long-term objectives and economic environment of the firm (both internally and externally) will enable the company to identify any threats, opportunities or limitations that it faces. By identifying threats and limitations early, the company will be better prepared to prevent them from occurring or to limit their effect. By identifying opportunities early, the company is in a better position to act appropriately and capitalize on these situations.

Part of this strategic plan will be a review of the capacity and the capital resources of the company. Though these two items are related, they will be looked at separately. **Capacity** is the ability of the company to produce its products or services. **Capital resources** are the company's fixed assets. Capacity may exceed capital resources if the company has arranged to use another company's resources to produce its product or is using facilities temporarily.

In the long term, the company will need to make certain that its capacity will be able to meet the expected demand and also decide how to obtain this capacity. The firm may either purchase or lease the necessary fixed assets, but a plan is required to determine how the company will obtain the necessary financing for whatever option it chooses (this is the process of Capital Budgeting).

By taking all of this information into account, the company is in a position to make **long-term business plans**. These plans may be related to dropping or adding product lines or specific products, making long-term capital investments in increasing capacity or capital resources, or decreasing these. It may also generate a plan that will lead the company into a different business model altogether (for example, a shift from production of a product to servicing and supporting the product, leaving production to another company).

Note: Strategic planning is **directional, rather than operational**. This means the company focuses on where it wants to go instead of specifically how it will get there.

Intermediate and Short-Term Plans

The strategic plan is then broken down into **intermediate or tactical plans** (one to five years), which are designed to implement specific parts of the strategic plan. Tactical plans are made by upper and middle managers.

Short-term or operational plans (one week to one year) are developed from the tactical plans. Operational plans focus on implementing the tactical plans to achieve operational goals, and operational plans include budgeted amounts. It is operational plans that drive the day-to-day operations of the company. Operational plans are developed by middle and lower-level managers.

The shorter the time frame, the lower the level of management that should make the plan. Thus, strategic plans are developed by top management, tactical plans are developed by upper and middle managers, and operational plans are developed by middle and lower-level managers. This means that the board of directors should not be involved in developing weekly work plans for an assembly line.

All shorter-term plans need to work towards the strategic plans of the company. If the tactical and operational plans are not working towards that goal, the company will not be able to meet the longer-term, strategic goals that they have set.

Short-term or operational plans are the primary basis of budgets. Operational plans refine the overall objectives from the strategic and tactical plans in order to develop the programs, policies and performance expectations required to achieve the company's long-term strategic goals.

Most budgets are developed for a period of one year or less. Thus, the budget formulates action steps from the organization's short-term objectives. The budget reflects the company's operating and financing plans for a specific period: a year or a quarter or a month. The budget contains the action plans to achieve the short-term objectives.

The one exception to this is the capital expenditures budget. The capital expenditures budget is generally developed for a long period of time and the relevant impact is incorporated into the operating and financial budgets each year.

Other Types of Plans

Plans may also be **single-purpose plans**, which are developed for a specific item such as construction of a fixed asset, the development of a new product or the implementation of a new accounting system. These are also incorporated into the operating and financial budgets during the relevant years.

Standing-purpose plans have relevance and use for many different items. Plans such as marketing and operation plans fall into this category.

Contingency planning is planning that a company develops to prepare for possible future events (especially negative events). This is in a sense "what if?" planning. Preparing different plans for different situations is more expensive because it entails developing multiple plans. However, multiple plans for different situations enable the company to be better prepared for what may occur. Companies do this when they think that the cost of contingency planning will eventually lead to greater savings than the cost of the planning itself.

Contingency plans are much more important for companies that are more likely to be significantly influenced by outside events. If there is no plan for a situation in which a negative event occurs, the damage will be much greater to the company because it will not be able to react quickly, and its immediate reaction may not be the correct one. A contingency plan enables companies to respond quickly and in the best possible manner.

Note: Despite the benefits of having a formal plan, there are also some drawbacks to this process. A plan that is too formal can constrain creativity, or a strict dedication to the plan can cause the company to miss some opportunities that would be beneficial to them.

Question 2: Certain phases of the planning process should be formalized for all of the following reasons except that:

- a) Informal plans and goals lack the necessary precision, understanding and consistency.
- b) Formal plans can act as a constraint on the decision-making freedom of managers and supervisors.
- c) Formalization requires the establishment and observance of deadlines for decision-making and planning.
- d) Formalization provides a logical basis for rational flexibility and planning.

(CMA Adapted)

Question 3: Strategy is a broad term that usually means the selection of overall objectives. Strategic analysis ordinarily excludes the:

- a) Trends that will affect the entity's markets.
- b) Target production mix and schedule to be maintained during the year.
- c) Forms of organization structure that would best serve the entity.
- d) Best ways to invest in research, design, production, distribution, marketing and administrative activities.

(CMA Adapted)

Question 4: Which one of the following management considerations is usually addressed first in strategic planning?

- a) Outsourcing.
- b) Overall objectives of the firm.
- c) Organization structure.
- d) Recent annual budgets.

(CMA Adapted)

Budgeting

The Relationship Among Planning, Budgeting and Performance Evaluation

Planning, budgeting and performance evaluation are interrelated and inseparable. Here is an overview of the process:

- 1) Management develops the **plan**, which consists of goals, objectives and a proposed plan of action for the future. The plan includes the company's short-term as well as long-term goals and objectives and its business opportunities and risks. For example, a plan may look at the future from the perspective of expanding sales, increasing profit margin, or whatever the company sees as long-term goals. In the process of determining its plans and goals, management will look at external economic factors (the expected labor market, tax rates, health of the economy, etc.) as well as what they currently do well or need to fix. The plan is a guide showing where the company needs to be in the future. The budget should include performance of the company as a whole as well as the performance of its individual departments or divisions. Managers at all levels need to reach an understanding of what is expected.
- 2) The plan developed by management leads to the formulation of the budget. The budget expresses management's plans for the future in **quantitative terms**. The budget also identifies the resources that will be required in order to fulfill management's goals and objectives and how they will be allocated.
- 3) Budgets can lead to changes in plans and strategies. Budgets provide **feedback to the planning process** because they quantify the likely effects of plans that are under consideration. This feedback may then be used by managers to **revise their plans** and possibly their strategies as well, which will then cause revisions to the budget during the budgeting process. This back and forth exchange may go on for several iterations before the plans and the budget are adopted.
- 4) Once the plans and the budget have been coordinated and the budget adopted for the coming period, as the organization carries out its plans to achieve the goals it has set, the master budget is the document it relies upon as its operating plan. By budgeting how much money the company expects to make and spend, the company creates a series of ground rules for people within the organization to follow throughout the year.
- 5) Actual results are compared to the plan. The budget is a **control tool**. Controlling is defined as the process of measuring and evaluating actual performance of each organizational unit of an enterprise and taking corrective action when necessary to ensure accomplishment of the firm's goals and objectives. The budget functions as a control tool because it expresses what measures will be used to evaluate progress. **A regular (monthly or quarterly) comparison of the actual results — both revenues and expenditures — with the budgeted results will give the company's management information on whether the company's goals are being met.** This comparison should include narrative explanations for variances, discussing the reasons for the differences, so that mid-course corrections can be made if necessary.

- 6) Sometimes, this control will result in the revision of prior plans and goals or in formulation of new plans, changes in operations and revisions to the budget. For example, if changes occur in the company's external environment that cause variances in revenues and/or costs to become extreme, a new short-term plan and a revised budget covering the remainder of the year may be necessary in order to properly respond to the changes occurring.
- 7) Changed conditions during the year will be used in planning for the next period. For example, if sales decline, the company may plan changes in its product line for the next period in order to reverse the trend.

The **master budget** is the culmination and the goal of the budgeting process. The master budget is a summarized set of budgeted financial statements, including **budgeted balance sheet**, **budgeted income statement**, and **budgeted statement of cash flows**.

A projected financial statement is called a **pro forma financial statement**; however, the master budget is not called a pro forma financial statement. The term **pro forma** is used to refer to a forecasted financial statement prepared for a specific purpose, for example to do "what if" analysis in the process of planning. A company might prepare many different sets of pro forma financial statements for the same period in its planning process. A pro forma financial statement is not used for formal variance reporting as the master budget and the flexible budget are, although if an action that was forecasted is implemented, the company would probably want to compare the actual results with the forecasted, pro forma, ones. But pro forma financial statements are not a part of the formal budgeting process. They are used for planning and decision-making purposes, and the amounts in them may be quite different from the amounts in the master budget. Planning and the use of pro forma financial statements is discussed more in the topic of Top-Level Planning and Analysis in this section.

The master budget is prepared for just one activity level, and the activity level used is whatever it is projected to be before the period begins. When flexible budgeting is used, the flexible budget is also prepared for just one activity level, but that activity level is the **actual** activity level achieved during the period. Therefore, the flexible budget amounts cannot be finalized for a reporting period (usually a month at a time) until the period is past and the actual achieved activity level for that period is known. The master budget and the flexible budget will be discussed in detail in the section on Budget Methodologies.

The master budget is created using both non-financial and financial assumptions, which come about as a result of the planning process. For instance, companies develop budgets for the number of units of each product that they expect to manufacture and sell, the number of employees they will need, and so forth. The master budget is a result of both operating and financing decisions. **Operating decisions** are concerned with the best use of the company's limited resources. **Financing decisions** are concerned with obtaining the funds to acquire the resources the company needs.

A budget that is broken down according to departmental lines will provide more feedback and function as more of a control tool than one that is not departmentalized, because each department manager will be responsible for meeting his or her department's budget. Ideally, each department manager will also have been responsible for developing his or her department's budget. These underlying budgets are used in developing the master budget. The master budget is the **consolidation** of all the departmental budgets. It comprises operating budgets and financial budgets.

Operating budgets are used to identify the resources that will be needed to carry out the planned activities during the budget period, such as sales, services, production, purchasing, marketing, and R & D. The operating budgets for individual units are compiled into the budgeted income statement.

Financial budgets identify the sources and uses of funds for the budgeted operations. Financial budgets include the cash budget, budgeted statement of cash flows, budgeted balance sheet, and the capital expenditures budget.

Advantages of Budgets

When properly developed and administered, budgets

- Promote **coordination** and **communication** among organization units and activities,
- Provide a **framework for measuring performance**,
- Provide **motivation** for managers and employees to achieve the company's plans,
- Promotes the **efficient allocation of organizational resources**,
- Provide a means for controlling operations, and
- Provide a means to check on progress toward the organization's objectives.

Coordination and Communication

Coordination means balancing the activities of all the individual units of the company in the best way so that the company will meet its goals and the individual units of the company will meet their goals. For example, when the sales manager shares sales projections with the production manager, the production manager can plan and budget to have the needed inventory ready to sell. And the sales manager can make better forecasts of future sales by coordinating and communicating with branch managers, who may be closer to the customers and know what they want.

Measuring Performance

Budgets make it possible for managers to measure actual performance against planned performance. The current year's budget is a better benchmark to measure current performance against than is last year's results. Last year's results may have been negatively impacted by poor performance and the causes have now been corrected. Using last year's results would set the bar too low. Furthermore, the past is never a good predictor of the future, and the budget should reflect the conditions anticipated for the coming period, not the conditions that existed in the past period or periods.

Performance should not be compared only against a budget, though, because that can result in lower level managers setting budgets that are too easy to achieve. It is also important to measure performance relative to the performance of the industry and even relative to prior years' performance.

Motivating Managers and Employees

Challenging budgets improve employee performance, because no one wants to fail, and falling short of the budgeted numbers is perceived as failure. Goals should be demanding but achievable. If they are so high that they are impossible to achieve, however, they are de-motivating.

Efficient Allocation of Organizational Resources

The process of developing the operating budgets for the individual units in the organization includes identifying the resources that each unit will need to carry out the planned activities. For example, the process of developing the production budget requires projections for direct materials and direct labor that will be required to produce the planned output. The process of budgeting for administrative salaries requires forecasts of administrative employees that will be needed by each department. If funds will be available for only a certain number of administrative employees in the organization, some units' projections may have to be adjusted. This leads to efficient allocation of organizational resources.

Characteristics of Successful Budgeting

There are a number of characteristics involved in successful budgeting, and some of these we have already mentioned.

- 1) The budget must **start with the company's short- and long-term plans**. Without input from planning, the budget will usually just recreate the previous year's results with minor changes, making it useless as a planning tool.
- 2) The budget must have the **support of management at all levels**. The support of top management is critical to gain the support of lower-level managers, and the support of lower-level managers is critical in order to gain the support of the affected employees.
- 3) The people who are charged with carrying out the budget need to **feel ownership of the budget**. That means they need to have input into the budget's development rather than having the budget imposed upon them.
- 4) The budget should be a **motivating device**. It should help the people in the organization to work toward the organization's goals for the improvement of the company. The budget is more likely to be successful if everyone concerned, from managers to their employees, **sees the budget as a tool to help them do a better job**, and not as a rigid taskmaster or as a tool for top management to use to assess blame.
- 5) The firm's management should assess the future as it pertains to the firm's strategic goals and **use the budgeting process to minimize the adverse effects** that anticipated problems may have on operations.
- 6) A budget should be **flexible**. If conditions change during the budget period, the budget should not be used as an excuse for not doing something that is strategically important to the company, such as acting on an unforeseen business opportunity that arises. Or, if an unplanned large maintenance expense is needed, the budget should not require a manager to postpone repairs if doing so will hurt the company in the long run. The expression, "It's not in the budget" should not be used. In situations like these, the budget should be able to be changed.
- 7) To be useful, the budget should be an **accurate representation** of what is expected to occur. A budget with inaccurate numbers will not have the confidence of the people who are affected by it and will be useless. The accuracy of the budget can be affected by the means used to reward managers. If managers are rewarded according to how far above the budget their revenues are and/or how far below the budget their expenses are, they may be motivated to build "budgetary slack" into their budgets (budgeting revenues low and expenses high), resulting in an inaccurate budget. It may be more beneficial to reward managers based on how **accurate** their forecasts have been when compared with actual results.
- 8) A budget should be **coordinated**, and operating activities of diverse business units should be synchronized. For example, the sales manager will want to make as many sales as possible, whereas the credit manager will want to limit bad debt write-offs. A coordinated effort to establish credit standards that both managers can support should be incorporated into the budgeting process.
- 9) Budgeting should **not be rigid**. If revenue decreases are anticipated for the coming year, an "across the board" cost reduction applied to all areas can create additional problems.
- 10) The **time period for a budget should reflect the purpose of the budget**. If a new product is under consideration and the purpose is to budget for the total profitability of the product, the capital budgeting period should include the design, manufacturing, sales and after-sales support for the expected life of the product.

Time Frames for Budgets

A budget is generally prepared for a set period of time, commonly for one year, and the annual budget is subdivided into months or possibly quarters. Usually a budget is developed for the same time period as is covered by a company's fiscal year. When the budget period is the same as the fiscal year, budget preparation is easier and comparisons between actual results and budgeted results are facilitated. (This comparison is called a variance report.)

Budgets can also be prepared on a continuous basis. At all times, the budget covers a set number of months, quarters or years into the future. Each month or quarter, the month or quarter just completed is dropped and a new month or quarter's budget is added on to the end of the budget. At the same time, the other periods in the budget can be revised to reflect any new information that has become available. Thus, the budget is continuously being updated and always covers the same amount of time in the future. This is called a **rolling budget** or a **continuous budget**.

When continuous budgeting is used, budgeting and planning are always being done. Advantages are:

- Budgets are no longer done just once a year.
- A budget for the next full period (usually 12 months) is always in place.
- The budget is more likely to be up-to-date, since the addition of a new quarter or month will often lead to revisions in the existing budget.
- Managers are more likely to pay attention to budgeted operations for the full budget period.

Firms usually have longer-term budgets, as well. Budgets for the years beyond the coming year usually contain only essential operating data, though, and do not attempt to present a full operating and financial budget. But having a long-term budget along with the coming year's master budget enables management to quantify the effect of its strategic plans on future short-term operations.

Who Should Participate in the Budgeting Process

All levels of management need to participate in the budgeting process. Management at all levels of the company need to understand and support the budget. For this reason, budgeting needs to be both **bottom up** and **top down**.

Lower-level managers need to be involved, and this is the **bottom up** part.

- Their knowledge is more specialized and they have the hands-on experience of running the business on a day-to-day basis.
- Their participation will make them more committed and more accountable for meeting the budget.

Top management support is essential, and this is the **top down** part.

- The support of top management is needed in order to obtain successful development and administration of the budget
- Top management support is necessary in order to gain lower-level management participation. If lower level managers feel that top management does not support the effort, they are not likely to support it either.

The Budget Development Process

We will discuss specific budgets and their development later. However, the process for developing each budget is the same.

- 1) **Budget guidelines are set and communicated.** This may be done by a budget committee or by senior management. The initial budget guidelines govern the preparation of the budget. Information considered in the development of the budget guidelines includes the general outlook for the economy and the markets the company serves, strategic objectives and long-term plans, expected operating result for the current period (since a budget for the coming period is developed toward the end of the current period but not after the current period has been completed), specific corporate decisions for the coming period such as corporate downsizing, response to environmental requirements, and short-term objectives.
- 2) **Initial budget proposals are prepared by responsibility centers.** Each responsibility center manager prepares an initial budget proposal, using the budget guidelines as well as their own knowledge about their own area, such as introduction of new products or changes to be made in product design or manufacturing processes.
- 3) **Negotiation, review and approval.** The responsibility center managers submit their initial budget proposals to the next level up for review. The initial proposals are reviewed for their adherence to the budget guidelines and to determine whether the budget goals are reasonable and in line with the goals of the next higher unit and with those of other budget units. Any changes that are needed are negotiated between the responsibility center managers and their superiors. The budgets go through successive levels of management and at each point may be re-negotiated. These negotiations are the most important part of the budget preparation process and also the most time-consuming part. Eventually, all of the individual unit budgets are combined into a consolidated master budget (first draft). That consolidated master budget is reviewed at the topmost level to determine whether it meets the requirements without being unachievable, and negotiations begin again for revisions. Finally, when the consolidated master budget meets the approval of the budget committee or senior management, the CEO approves the entire budget and submits it to the board of directors for final approval.
- 4) **Revisions.** Even after the budget has finally been adopted, it should be able to be changed if the assumptions upon which it was built change significantly. New information about internal or external factors may make revision of the budget necessary. In addition, periodic review of the approved budget for possible changes or use of a continuous budget which is continually being updated might be advisable. Although updating the budget provides better operating guidelines, too-frequent and too-easy budget revisions might encourage responsibility centers to not take the budgeting process seriously enough. Therefore, the budget should be revised only when circumstances have changed significantly and the changes are beyond the control of the responsibility center manager or the organization.
- 5) **Reporting on variances.** A budget is meaningless unless actual results are compared to the planned results for the same period. The budget needs to be used to monitor and control operations to meet the company's strategic objectives. The comparison between actual and plan is called variance reporting, and it should take place at every budget unit level. Responsibility center managers should report on variances within their responsibility centers at the end of each reporting period (monthly or quarterly) to their superiors, who then compile the reports they receive into a variance report that is sent to the next level up, and so on. Variance reporting should include not only the amounts of the variances but also the causes of the variances that can be identified.
- 6) **Use of the variance reports.** The variance reports should be used at every level to identify problem areas and to make adjustments to operations, if necessary. For example, a production variance report might reveal that direct materials usage during the past month was greater than planned for the actual output that was produced. The production manager should be the one to investigate that and determine the cause. The variance may have been caused by inferior materials that included too much defective material. If that is the case, then the purchasing manager may need to get involved in the variance reporting, since the purchasing manager is responsible for the materials purchased. If a change in supplier is needed to correct the situation, that change should be made immediately.

Best Practice Guidelines for the Budget Process

Best practices in budgeting include the following, most of which we have already discussed:

- **The development of the budget should be linked to corporate strategy.** Linking them gives the managers and employees a clearer understanding of strategic goals, which leads to greater support for goals, better coordination of tactics, and, ultimately, to stronger company performance.
- **Communication is vital.** Management must communicate strategic objectives. But in order to develop those objectives, management needs information from all areas of the organization about customers, competitors, the economy, new technology, and so forth. Much of this information comes from customer contact and support units. Effective communication among all levels of the organization leads to challenging but achievable budgets.
- **Design procedures to allocate funding resources strategically.** This can be done during the review process for the individual responsibility center budgets. Managers reviewing several responsibility center budgets can see how changes in one budget will affect other budgets. The company's weighted average cost of capital should be a consideration in the allocation process, as well. The degree of risk involved in competing plans, the costs or advantages associated with deferring action, as well as factors such as expected developments in interest rates may also be used to allocate resources. By using these types of measures to allocate funding, companies can better select plans whose benefits will produce the desired results. And by monitoring the results of their allocations, companies can refine and improve their allocation procedures.
- **Managers should be evaluated on performance measures other than meeting budget targets.** Meeting budget targets should be secondary to other performance measurements. See the topic of Budgetary Slack immediately following this one and the section on Performance Measurement in this textbook for further discussions of this.
- **Link cost management efforts to budgeting.** Accurate cost information during the budgeting process is basic to budgeting. Companies that use accurate cost management techniques and provide managers developing their budgets with access to cost information improve both the accuracy and the speed of their budget process.
- **The strategic use of variance analysis.** Use of variance analysis to identify weaknesses enables managers to identify areas where their organization needs to improve its performance. However, this attention should be focused on those variances that have a significant impact on profitability, so that decision making and budgeting do not get bogged down in insignificant details.
- **Reduce budget complexity and budget cycle time.** The budget process should be streamlined as much as possible through controlling the number of budgets that are needed and by standardizing budgeting methods. Automate budgeting as much as possible through the use of information technology, and make sure that the budget developers know how to use new technologies.
- **Develop budgets that can be revised if necessary.** By having a process in place to revise the budget when change is warranted, a company can respond to competitive threats or opportunities more quickly. Furthermore, when budget developers know that the budget will have some flexibility, they will feel less need to pad their budgets with budgetary slack (see below for discussion of budgetary slack), which they otherwise might do in order to cover any possible development. This leads to more realistic budgets.
- **Review the budget on a regular basis throughout the year.** These reviews should report on changes in business conditions and alert managers that new tactics may be called for if they are to meet their targets for the year. This goes along with revising the budget when necessary. The budget should not be revised to cover up for poor performance or poor planning, but best practice companies choose to revise the budget rather than stick with a budget that no longer reflects current conditions.

Budgetary Slack and Its Impact on Goal Congruence

Goal congruence is defined as “aligning the goals of two or more groups.” As used in planning and budgeting, it refers to the aligning of goals of the individual managers with the goals of the organization as a whole. Sometimes, the performance of an individual manager’s unit will benefit from an action, but the overall performance of the company is either not impacted at all or it may actually be negatively impacted. Or, an individual division manager may reject a capital investment that would improve the company’s total profits because the proposed project’s return on investment would cause his own division’s return on investment to decrease. When things like these occur, it is because the goals of the individual managers are not aligned with the goals of the company.

The company’s strategic objectives are communicated to individual managers as part of the planning and budgeting process. However, there is a hazard in budgeting, because it may lead to behaviors on the part of managers that benefit them but are not congruent with the goals of the company. This is more likely to occur if managers’ performance will be evaluated according to whether they meet their budget targets. Managers who develop the budgets they are going to be accountable to meet may build **budgetary slack** into their budgets in order to make sure their budgets are achievable without any risk of failure. Budgetary slack is the difference between the budgeted performance and the performance that is actually expected. It is the practice of underestimating budgeted revenues and overestimating budgeted costs to make the overall budgeted profit more achievable.

On the positive side, budgetary slack can provide managers with a cushion against unforeseen circumstances. This can limit managers’ exposure to uncertainty and thereby reduce their risk aversion. The reduced anxiety about risk may help the managers make decisions that are more closely congruent with the goals of senior management. Or, it may not. Budgetary slack creates more problems than it solves.

The negative results of budgetary slack are that it misrepresents the true profit potential of the company and can lead to inefficient resource allocation and poor coordination of activities within the company. The planning inaccuracy spreads throughout the company. For instance, if sales are planned too low, production will also be planned too low, possibly leading to product shortages; the advertising program and distribution expense budgets may be planned incorrectly; the cash budget might be inaccurate; and so forth.

The best way to avoid the problems of budgetary slack is to use the budget as a planning and control tool, but not for managerial performance evaluation. Or, if the company does use the budget to evaluate managers, it could reward them based on the accuracy of the forecasts they used in developing their budgets. For example, the company’s senior management could say that the higher *and* more accurate a division manager’s budgeted profit forecast is, the higher will be the manager’s bonus.

Responsibility Centers and Controllable Costs

Control in an organization is exercised through responsibility centers. Therefore, as we have maintained throughout this discussion, budgeting must also be done at the responsibility center level. However, responsibility center managers should be responsible for budgeting only the costs that they can control.

Some costs are controllable by a given manager and some costs are not. When referring to costs that are controllable, we are referring only to costs for which the manager has the authority to make the decisions about how the money will be spent. When we refer to non-controllable costs for a manager, we are referring to costs that are ordinarily controlled at a higher level in the organization, such as the manager’s salary or bonus. The manager’s salary or bonus **is** controllable, but not by the manager. However, the manager’s salary will usually be assigned to his or her responsibility center’s budget and will appear on reports comparing actual results to the budgeted amount.

The allocation of indirect costs may be another non-controllable cost, since indirect costs may be allocated on any of a number of bases, some of which may be controllable by the manager of the responsibility center and some of which may not be.

Each budgeted cost assigned to a responsibility center should be identified as either controllable or non-controllable by that responsibility center's management. For example, salaries in the accounting system may be segregated in two accounts: controllable salaries and non-controllable salaries. Each would then be budgeted by the person who has control over it, and that person would be responsible for explaining the variances.

All costs should be included on **some** manager's variance report and identified as the responsibility of that manager. If an expense is classified as non-controllable on a given manager's budget reports, then that expense should be included as a controllable expense on the report of the higher-level manager who makes the decisions that affect that expense.

It is also important to recognize that fixed costs and indirect costs are not necessarily uncontrollable, and variable costs and direct costs are not necessarily controllable. The nature of each cost will vary according to its characteristics.

This distinction between controllable and non-controllable costs is especially important if a manager's performance evaluation will be dependent upon meeting budgetary targets. (Although we have said this is not a good idea, it may be done in some organizations, anyway). If other performance measures are used to evaluate the manager, this distinction may be less important. However, the person who is responsible for making the decisions that affect a cost should still be the person who reports on variances between the actual and budgeted costs, because that person is responsible for budgeting the cost and for making spending decisions. That person should also be the one to make any operational adjustments that those variances may identify as needed.

Cost Standards in Budgeting

The term "standard cost" is almost a synonym for "budgeted cost." We will discuss standard costing in more detail later, because a standard cost system is a common method of cost measurement for manufacturing costs. For now, a few basic concepts are important because standard costs are also budgeted costs.

Standard costs are costs for direct materials, direct labor and manufacturing overhead that are **predetermined** or **estimated** as they would apply under specified conditions. Standard costs are a fundamental element of the budgeting process. They are used to develop the budgeted costs for manufactured goods.

Standard costs can be developed using various assumptions, and management needs to determine what assumptions to use in their development. Standard costs may be either:

- **Ideal, also called theoretical costs**, attainable only under the best possible conditions; or
- **Currently attainable, also called practical or expected costs**, challenging to attain, but attainable under normal conditions.

Currently attainable or practical expected costs are the costs that are used in most standard costing systems and are incorporated into the flexible budget.

Note: A flexible budget is a budget that is prepared using the standard costs and the **actual** level of sales. It is essentially what the budget would have been if the company had known the actual level of sales when it developed the budget. Flexible budgeting is covered in much more detail in the section on Budget Methodologies in this textbook.

Ideal, theoretical costs are probably not attainable and so are not practical for use in standard costs, but they can be useful for some special analytical and decision-making purposes and as goals to strive for.

A standard cost specification is developed for each product (in process manufacturing) or for each job (in job-order manufacturing). It consists of the standard costs for material, labor, and overhead for the product or job, and it is developed by means of cost analyses and engineering studies. In developing a standard cost specification, the costs for materials, labor and overhead in each of the various responsibility centers through

which the work flows are included in the analysis. Standard cost specifications are designed in accordance with each individual situation.

Flexible budgets work with standard cost systems. The standard cost system provides data for the computation of the predetermined overhead rates to use in the flexible budget and for variance analysis of overhead expense. **Most companies use practical expected standard costs in their standard cost system and in their flexible budgets.** If they choose not to do this, then management will have an additional variance to report: the variance between the practical expected costs and the ideal theoretical costs.

Setting Standard Costs

Standard costs are derived from general standards for operations. Several resources are used in determining standards for operations. These are:

- Activity analysis,
- Historical data,
- Target costing,
- Strategic decisions, and
- Benchmarking.

Activity Analysis

Activity analysis is the **most accurate way of determining standard costs**, if it is properly executed. It involves identifying and evaluating all the input factors and activities that are required to complete a job, a project or an operation efficiently. Activity analysis is performed by people from several different areas, including product engineers, industrial engineers, management accountants and the production workers.

Product engineers specify the components to be used in the manufacturing of a product. Industrial engineers analyze the procedures required to complete the manufacturing process. Management accountants work with the engineers to complete the analysis.

The analysis specifies the quantity and the quality of the direct materials, the required skills and experience of the employees who will produce the product, and the equipment to be used in producing the product. The management accountants contribute the costs of the direct materials, the employees, the overhead and other items to arrive at the total standard cost.

Historical Data

While activity analysis is the most accurate means to determine standard costs, the cost of the activity analysis itself can be prohibitively high. If a firm cannot justify the high cost of activity analysis, it can use historical data instead. Data on **costs involved in the manufacture of a similar product in prior periods** can be used to determine the standard cost of an operation, if accurate data is available.

Analysis of historical data is much less expensive than activity analysis for determining standard costs. However, a standard cost based on the past may perpetuate past inefficiencies. Furthermore, a standard based on the past does not incorporate continuous improvements, which are an important standard in the competitive environment in which businesses operate today.

Target Costing

Target costing is used when a firm has a set selling price at which it desires to sell its product in order to be competitive. The target cost is **the cost that yields the required profit margin for the product**, given a set selling price. Standards are then determined so that the product can be manufactured at the target cost.

Strategic Decisions

Strategic decisions can also affect a product's standard cost. If management has made a strategic decision to pursue **kaizen**, the Japanese term for **continuous improvement**, this will impact the standard because the standard will be set at the most challenging level at all times. Other strategic decisions that can affect a product's standard cost include things like a management decision to replace an obsolete piece of equipment with a new machine will require that standards and standard costs be updated.

Benchmarking

Input into the standard-setting process may come from **benchmarks**, or industry information about current practices of other firms. These other firms need not be in the same industry or country. If they have similar operations, they can offer good guidelines even if they are from a different industry or country. Benchmarking data can also come from associations of manufacturers that collect information from their members.

In benchmarking, the best performance anywhere can be chosen as the attainable standard. Using the best-performing company as a standard can help a firm maintain its competitive edge. However, the benchmark must be evaluated in light of the company's own unique situation.

The Standard-Setting Process

The standard costs developed for use in the accounting system can, and indeed should, also be used in developing the production budget.

A company can use either an **authoritative** or a **participative** procedure in setting the standard costs that will be used in the standard cost system and in the flexible budget.

- When following an **authoritative** standard-setting process, management sets the standards and they are handed down to those charged with their execution. Advantages of an authoritative standard-setting process include: proper consideration of all the factors that will affect the costs; management's expectations will be reflected in the resulting standard costs; and the standard-setting process can be handled more expeditiously than when more individuals are involved. The disadvantage of authoritative standard-setting is that the affected employees will not see them as their own and will be less likely to accept them, which in turn will reduce their motivation to achieve the standards.
- A **participative** standard-setting process involves all the employees who will be affected by the standard. When employees participate in setting the standards, they are more likely to accept them and not see them as unreasonable. The disadvantage to setting standards in a participative manner is that the resulting standards may not support achievement of the firm's strategic goals or operating objectives.

Even when an authoritative standard-setting process is followed, production employees and supervisors must be involved in some aspects of the process. These people are close to the production process, and their input is important if management expects to do a good job of setting the standards. The actual standard-setting is accomplished through the efforts of management, product design engineers, industrial engineers, management accountants, production supervisors, purchasing, personnel, and employees affected by the standards.

Establishing Direct Materials Standards

Three considerations go into establishing a standard cost for direct materials:

- Quality,
- Quantity, and
- Price.

Specifying the **quality** is the first step, because the quality of the direct materials will affect all phases of production, such as the quantity of the materials that will be required, the time required for processing, and

the amount of supervision that will be needed during the production process. The marketing department, engineering department, production department and management accountants all need to be involved in making the determination of the quality in order to assess the trade-offs that will be involved as well as determine the **optimum quality that will produce the lowest overall cost**.

After the quality has been specified, the standard for the **quantity** of direct materials needed to manufacture the product is set. The quantity standard is based upon the product design, the cost drivers of the manufacturing activities, the quality of the direct materials, and the condition of the plant and equipment that will be used to manufacture the product. The industrial engineering department, the production department and the management accountants work together to develop the quantity standard.

The **price** standard is developed after the quality and quantity standards, because the quality and quantity standards are considerations in setting the price standard. Timing of the purchases is a consideration, as well. A vendor's record of reliability for delivering the product on time is often more important than finding the lowest price, because the result of shopping only for price may be missed deliveries.

Establishing Direct Labor Standards

The standard for direct labor depends on the type of work, the nature of the manufacturing process, the type of equipment that will be used, and the required skill level of the employee.

The **quantity** standard for direct labor is determined by the industrial engineers, the production department, the labor union, the personnel department, and the management accountants, using the factors listed above.

The **price** standard for direct labor, or the standard **wage rate**, is provided by the personnel department and is a function of the competitive labor market and any labor contracts that may exist. The standard wage rate varies according to the type of employees needed and the skill level required.

The cost standard for labor, whether direct or indirect, includes not only the hourly wage or salary paid, but also the employee benefits provided and the payroll taxes that must be paid. Employee benefits may include medical insurance, life insurance, pension plan contributions, and paid vacation. Payroll taxes include unemployment taxes and the employer portion of Social Security and Medicare taxes. Workers' compensation insurance is a requirement, as well. Estimates of these other costs should be made and included in the direct labor standard cost.

Establishing Overhead Standards

Overhead standards are generally based on normal operating conditions, normal volume, and desired efficiency. The total overhead costs come from the budgeted factory overhead costs. These are divided by a **predetermined level of activity** to calculate a standard overhead rate.

Determining the Level of Activity

In relation to the allocation rate, the company must decide what activity to use for its budgeted amount of the activity level. The traditional method uses either machine hours or direct labor hours to allocate overhead. The company must decide how much output it will produce during the coming year. And, as a function of output, how many machine hours, or how many direct labor hours, it plans to use during the year. As this is one of the two figures used in the determination of the manufacturing overhead rate, it will greatly impact the allocation rate.

The allocation rate is established for the full year. The budgeted overhead rate for the year multiplied by each month's budgeted activity level will be used to calculate the monthly budgeted overhead (see example following this explanation).

In general, a company has four choices to determine the output level. Two relate to what the plant can **supply**; and two relate to the **demand** for the plant's output. These are called **denominator-level capacity concepts**, because they describe the denominators that can be used in the calculation of per unit overhead costs.

Supply Denominator-Level Concepts

- **Theoretical or ideal capacity** – This is the level of activity that will occur if the company produces at its absolute most efficient level at all times. (This means no allowances for idle time and downtime and no decrease in sales demand). This is not a good basis to use because a company will not be able to achieve this level in the long run.
- **Practical (or currently attainable) capacity** – This is the theoretical level reduced by allowances for idle time and downtime, but not for a decrease in sales demand.

Demand Denominator-Level Concepts

- **Master budget capacity utilization (or expected actual capacity utilization)** – Master budget capacity, also called expected actual capacity, is the amount of output actually expected during the next budget period based on expected demand. This level will result in a different overhead rate for each budget period because of increases or decreases in planned production due to expected increases or decreases in demand.
- **Normal capacity utilization** – This is the level of activity that will be achieved in the long run, taking into account seasonal changes in the business and cyclical changes. Seasonal changes in business result from the seasons during the year and cyclical changes are connected to the larger business cycle. Normal capacity utilization is the level of activity that will satisfy **average** customer demand over a long-term period such as 2-3 years. Though this will cause inaccuracies in some years, they will be offset in others. **This is the method that a company should generally use to determine the overhead standard cost.**

Usually normal capacity or expected actual capacity (also called master budget capacity) is used as the denominator in calculating the overhead standard rate.

It is much simpler if the activity level used in developing the overhead standard is the same activity level as is used in developing the budgeted overhead costs. If it is not, differences between budgeted costs and standard costs due to the different activity levels will appear in variance reports as additional variances.

Example: Total overhead is budgeted to be \$900,000 for the budget year. Output, based on normal capacity utilization, is budgeted at 500,000 units for the year. The overhead allocation rate, based on units of production, is \$1.80 per unit ($\$900,000 \div 500,000$). Overhead is allocated based on machine hours. So we need to convert that to a rate per machine hour. The standard number of machine hours for each unit produced is 1.5 machine hours, so total machine hours budgeted for the year is $500,000 \times 1.5$, or 750,000. Therefore, the amount of overhead to be budgeted for each machine hour allowed for the budgeted output is \$1.20 ($\$1.80 \text{ per unit} \div 1.5 \text{ machine hours per unit}$ OR $\$900,000 \div 750,000 \text{ machine hours}$).

Production is not planned to take place evenly throughout the year. The production budget for the first quarter calls for 40,000 units to be produced in January, 50,000 in February, and 45,000 in March. Therefore, budgeted overhead will be $(40,000 \times \$1.80)$ or \$72,000 in January, $(50,000 \times \$1.80)$ or \$90,000 in February, and $(45,000 \times \$1.80)$ or \$81,000 in March.

We can calculate the same amounts by using machine hours: January's budgeted machine hours is $40,000 \text{ production units} \times 1.5 \text{ machine hours per unit}$, or 60,000 machine hours. $60,000 \text{ machine hours} \times \$1.20 \text{ per machine hour} = \$72,000$ budgeted overhead for January, and so forth for February and March.

At the end of the year, the total budgeted overhead for the year should equal \$900,000. We will have allocated it unequally to each month in the year, based upon each month's budgeted output.

Budget Methodologies

Annual/Master Budget

The development of an annual budget for a large corporation may take many months to complete. This is because the annual budget is made up of several different budgets, and some budgets cannot be developed until other budgets have already been completed. For example, the sales budget will be the driving factor in determining how many units must be produced, and therefore the sales budget must be completed before the production budget can be completed.

One of the most important things that can be done in the process of developing the budget is involving all of the correct people. As we have said, this is not a process to be undertaken exclusively by upper management during their board meetings. Lower-level managers need to be involved, because they actually know what is possible and what is not and what resources are required to meet a specific level of activity.

This method of **participative budgeting** has a number of benefits to the organization. There is much greater support and acceptance of the budget by all of the people who were involved in the process and therefore the employees are more motivated. In addition, the budget will be set by people who are actually involved in the process, thereby increasing the accuracy or realism of the budget.

Similar in concept to participative budgeting is **bottom-up budgeting**. This is the system in which the budget is developed by starting at the lowest levels in the operations systems and building revenues and costs from there.

Having said all of this, **upper management** still needs to be involved in the budgeting process. They will **set the goals, establish the priorities and provide the necessary support** to make sure the process is completed correctly.

A **budget manual** details the budget process. One of the areas that must be included in the budget manual is the **communication and distribution** process. As one budget is completed, it must be sent to all of the departments whose budgets are based on that budget or which use the budgeted information in their own budgets.

A **planning calendar** is the document that sets forth all of the deadlines, policies and procedures of the budgeting process. By having a calendar like this, a firm greatly enhances its chances of having the budgeting system work as it is supposed to.

Question 5: Which one of the following best describes the role of top management in the budgeting process? Top management:

- a) Should be involved only in the approval process.
- b) Lacks the detailed knowledge of the daily operations and should limit their involvement.
- c) Needs to be involved, including using the budget process to communicate goals.
- d) Needs to separate the budgeting process and the business planning process into two separate processes.

(CMA Adapted)

Question 6: The budgeting process should be one that motivates managers and employees to work toward organizational goals. Which one of the following is least likely to motivate managers?

- a) Participation by subordinates in the budgetary process.
- b) Having top management set budget levels.
- c) Use of management by exception.
- d) Holding subordinates accountable for the items they control.

(CMA Adapted)

The Different Budgets

Within the budgeting process are a number of different budgets. We will take a look here at some of the individual budgets and what they are prepared for, as well as the order in which they are prepared.

Note: For the Exam, it will be helpful if you know the order in which the different budgets are prepared. Some of the questions may be based on the order of preparation. As you will see below, it is critical to **produce the sales budget first** so that the company knows how many units will need to be produced or purchased. The **cash budget is the last budget** that is prepared.

The Sales Budget

The sales budget shows the expected sales in units of each product and each product's expected selling price. The sales budget is based upon the firm's forecasted sales level, its short- and long-term objectives and its production capacity.

The first budget to be prepared is always the sales budget, because the production budget and all the other budgets for the company are derived from the sales budget. If sales are expected to be low, the company does not need as much inventory, as many sales people, and so on. On the other hand, if sales are expected to be high, more of each of these items will be required.

The sales budgets should be developed for each department individually or possibly for each sales person, depending upon the nature of the business. Additionally, the sales budget needs to be based on realistic estimates of sales, since this budget will be the driver behind all of the remaining budgets. If the sales budget is too optimistic, production will be too high, inventory will be too high, and problems such as cash shortfall will result. If the sales budget is too low, production and inventory will be too low, and sales will be lost because of a lack of product to sell.

The sales budget is probably the **most difficult to produce** because it relies entirely on information and estimations that are outside of the direct control of the company. The company has no direct control over the economy as a whole or over competitors and technological advances that may make the company's product obsolete.

Note: One more item that needs to be considered in the sales budget is the level of credit sales and collections. Though the timing of collections is not critical for the sales budget itself, the amount of collections is critical for the development of the cash budget (covered later).

The Production Budget

After determining the sales budget, the production budget matches the company's sales budget with its capacity and inventory objectives. If the company would like to increase its inventory, it will need to include this in its production plans. Similarly, if the company wants to decrease inventory, it will produce fewer units than it plans to sell. The final determination of how many units to produce is done in the **production budget**.

The production budget also includes **when** these units will be produced. The units must be produced prior to the time when they will be sold. If sales are expected in the early part of the year, production needs to be done early. If sales are expected to be later in the year, production needs to take place later in the year or the company will need to pay significant storage costs.

Note: If the prices of the inputs to the product are expected to change significantly in the future, this must also be taken into account in determining when and how many to produce.

As you can already see, the different budgets are all interrelated to each other, and a change in one will have an impact on at least one other budget.

The production budget provides the foundation for the development of the following budgets:

- Direct materials budget, including the purchases budget for raw materials, which is created in much the same way as the production budget, taking into account the desired change in inventory of raw materials;
- Direct labor budget; and
- Factory overhead budget, including both variable costs (such as utilities) and fixed costs (such as supervisory salaries that fall within the relevant range do not change as production levels change).

All of these budgets are interrelated because a change in one budget may require a change in another budget. As production changes, the amount of labor and material will change. As the amount of labor changes, there may need to be a change in indirect materials and indirect labor. Indirect materials are materials used in the manufacturing process but their costs are not directly traceable to any particular product. Indirect labor would be the same thing. An example of indirect labor would be the wages of a janitor who cleans up the plant, since his wages cannot be traced to any one product. As these items change, there may also be a change required in the overhead budget, caused by, for example, changes in the amount of electricity the company expects to use or changes in the required amount of equipment maintenance. Because of the way that individual budgets are connected to each other, a change in one budget will almost always affect at least one other budget.

Direct Labor Budget

The direct labor budget is also influenced by outside parties, especially labor unions. As labor contracts are completed and new contracts signed, this may cause an immediate change in the cost of direct labor. Additionally, any changes in the level of skill that is required of the labor force as a result of changing production technologies will also impact the direct labor budget.

The direct labor budget will also include all other employee costs, in addition to salaries. These other costs include employer contributions to Social Security (FICA) and Medicare, workers' compensation insurance for workers who are hurt on the job, federal and state unemployment taxes paid by the employer, health and life insurance premiums if they are provided, pension plan contributions paid by the company and any other employee benefits. These may all be presented in an **Employee Benefit Statement**.

Many employee related costs vary directly with salary costs, though some are fixed amounts. Variable amounts include the employer's portion of the social security contribution (up to a certain salary cap, at which point the social security contribution is no longer paid), employer's portion of Medicare, workers' compensation insurance, and unemployment compensation taxes. Pension plan contributions may be a simple percentage, if the plan is a defined contribution plan; or they may be a much more complex calculation, if the

plan is a defined benefit plan. But either way, they will be variable. Usually medical, dental and vision insurance premiums are fixed. Life insurance premiums may be fixed or variable, depending upon the terms of the policy and whether the amount of coverage is fixed or based on the employee's salary.

Most companies do not try to project employee related costs exactly. Instead, they develop a factor which is a weighted average cost and apply that factor to the total budgeted salaries and wages for a given employee group to calculate the budgeted employee related costs for that group. Even though some components of employee related costs are fixed, enough of them are variable to make this a valid way to budget for them. However, to develop that factor, companies do need to do some analysis of historical employee-related costs as a percentage of salaries and wages.

The company usually prepares several direct labor budgets, one for each type of labor used for production.

Note: The company must also choose **how** the costs of employee benefits – both actual and budgeted – will be treated. They may be included in the cost of direct labor or treated as an overhead and allocated to the units produced. In some cases, these costs may be treated as a period cost. The method in which these costs are treated may have a small effect on cost of goods sold, income or inventory. Only in cases where direct labor is a large portion of the total expenses will this difference be significant.

Cost of Goods Sold Budget

After all of the production related budgets are completed, the company can produce the **cost of goods sold budget**, which is based on the calculation of cost of goods sold, as follows:

	Beginning Inventory (this is a known quantity and not budgeted)
+	<u>Expected Budgeted Purchases or Production</u>
=	Expected Goods Available for Sale
–	<u>Desired Ending Inventory</u>
=	<u>Budgeted Cost of Goods Sold</u>

Other Budgets

Other budgets that will need to be prepared in order to **complete the budgeting process** and to have all of the necessary information to prepare budgeted financial statements are:

- Research and development (R&D) budget,
- Selling and marketing budget,
- Administrative and general expense budget,
- Budgets for other expenses or sources of revenue, and
- Capital budget. This is the budget for long-term capital expenditures, and any expenditures that are to be made in the budget year will need to be included in the budgeting process. Capital expenditures budgeted for the coming year will affect the budgeted balance sheet as increases in fixed assets and in accounts receivable, inventory and accounts payable; and they will affect the budgeted income statement as income expected from the new projects along with related expenses, including depreciation on the new equipment. Those that affect cash will, of course, also flow to the budgeted statement of cash flows.

Note: Each of the individual budgets prepared for expenses will also most certainly be broken down into variable and fixed costs. This is significant because of the fact that fixed costs cannot be changed. Also, the variable costs (particularly for overhead and selling and administration) are needed to determine the contribution margin from the business unit.

The Cash Budget

The cash budget^a (**or cash management and working capital budget**) is the last budget created because it draws upon information from all other budgets. It is also one of the most important budgets developed. The cash budget tracks the inflows and outflows of cash on a month-by-month (possibly even week-by-week or day-by-day) basis.

Note: Because cash flows depend on all of the other budgets, the budgeted statement of cash flows is the last budgeted financial statement prepared.

If this budget is accurate it will allow the company to plan for any cash shortfalls that may occur during the year and also enable the company to plan for any excess cash that may accumulate during the year. Any excess cash should be invested for the time period that it will not be needed.

One **advantage of predicting cash shortfalls** is that it will be easier (and less expensive) for the company to obtain a loan if it is aware of its need before the shortfall arrives and if it is able to present cash inflow and outflow projections to the bank. The company also would have more time to obtain permanent capital from equity sources by selling shares if that is the best alternative.

Note: Although all companies should prepare a cash budget, it is particularly important for those that operate as **seasonal businesses**. In addition, for a seasonal business, production, sales and ending inventory are also critical budgets.

The Operating and Financial Budgets

Once all of the budgets have been prepared, the company can prepare its master budget financial statements. Master budget financial statements will probably be prepared for each month of the budget period, or at least for each quarter. This is a very important process because by looking at what the financial statements and particularly the cash flows will be for each month during the period, the company is in a position to identify any potential problems.

These potential problems may relate to the company's existing loan agreements or restrictive covenants. If the organization can determine based on preliminary budgeted financial statements that it will be in violation of a loan covenant during (for example) the second quarter of the year, there will be time to take corrective actions to prevent the violation and to adjust the budget accordingly.

Also, if the company sees that it will not meet the expected (or desired) profits or other financial measures after the preparation of the budgets, it needs to go back and look at the plans for the year. However, when this reconsideration takes place, the company needs to be very careful to not perform unrealistic budgeting, and therefore not to make unrealistic changes to the budget.

The **operating budget** consists of all of the individual operating budgets, such as the sales or revenue budget, the production budget, the purchasing budget, the marketing budget and the research and development budget. All these individual operating budgets together are often called the **operating budget**. The operating budget is the budgeted income statement and the budget schedules that support it. The budgeted income statement must be completed before the budgeted balance sheet can be completed, since the net income from the income statement is a component of owners' equity.

After the operating budget is done, the company can evaluate the expected profit for the upcoming period. This evaluation may be done using earnings per share, an industry average or a price-earnings ratio.

The **financial budget** is a part of the master budget. It includes the **budgeted balance sheet**, the **budgeted statement of cash flows**, the **cash budget**, and the **capital budget**.

^a For the purpose of the Exam, the terms cash budget and budgeted statement of cash flows mean the same thing and may be substituted for each other in text or in questions.

The Capital Expenditures Budget

The capital expenditures budget is the budget in which all capital expenditures (these are expenditures for property, plant and equipment) are planned. If capital expenditures for the coming year will affect the balance sheet, income statement and cash flows, these capital expenditures must be reflected in the budgeted balance sheet, income statement and cash flow statement. This budget is often prepared years in advance so that the company is able to obtain the necessary financing or accumulate the necessary cash to carry out its capital expansion plans, and it covers multiple planning periods.

Capital expenditures are generally budgeted as separate projects covering several years each. Each project is analyzed separately to determine whether it is acceptable. This analysis is covered in the Capital Budgeting section of the CMA exams, currently in the Part 2 exam, so it will not be explained in detail here. However, for this exam, you may need to be able to determine the capital expenditures budget for a single period, based upon approved projects that will affect the upcoming planning period.

The capital expenditures budget consists of a list of each major project that has been approved and the amount to be funded for the coming year. The annual amount for each project is then broken down according to the quarter(s) or possibly month(s) when the expenditures for each project are expected to occur. The quarterly or monthly totals of cash funding requirements for all projects will be used in preparing the cash budget as well as the budgeted balance sheet. Any anticipated financing must also be included in the cash budget and the budgeted balance sheet. The budgeted balance sheet must reflect the investments and the financing; and the budgeted income and cash flow statements must reflect any net income planned for the coming period.

The depreciable life for each asset to be purchased is also shown on the capital expenditures budget, because that will be needed in calculating the budgeted depreciation expense for the budgeted income statement as well as accumulated depreciation amounts for the budgeted balance sheet.

The Master Budget

All of the budgeted financial statements are interconnected in the same manner as the actual year-end financial statements. The individual budgets that make up the operating and financial budgets (the budgeted balance sheet, income statement, cash budget or budgeted statement of cash flows, and the capital budget) together make up the master budget.

The master budget is the document the company relies on as its operating plan as it carries out management's plans in order to achieve its goals and objectives. It is a summary of management's operating and financial plans for the period, expressed as a set of budgeted financial statements for the period that reflects the impact of the operating decisions and financing decisions to be made during the coming period.

Question 7: Which one of the following items should be done first when developing a comprehensive budget for a manufacturing company?

- a) Determination of the advertising budget.
- b) Development of a sales budget.
- c) Development of the capital budget.
- d) Preparation of a pro forma income statement.

(CMA Adapted)

Question 8: Which one of the following statements regarding selling and administrative budgets is most accurate?

- a) Selling and administrative budgets are usually optional.
- b) Selling and administrative budgets are fixed in nature.
- c) Selling and administrative budgets are difficult to allocate by month and are best presented as one number for the entire year.
- d) Selling and administrative budgets need to be detailed so that the key assumptions can be better understood.

(CMA Adapted)

Flexible Budgets

When a company develops its budget for a future period, it doesn't know what its actual sales and production volumes will be during that period. All revenues and costs in the master budget are based on **forecasted** volumes. The master budget is a **static budget**, because it is developed for one specific sales level. When variance reports comparing actual results to budgeted results in the master budget are prepared and causes for the variances are reported, one of the causes will always be that actual sales volume was different from planned sales volume.

This is normal. A company must be flexible enough to respond to changes in demand by increasing or decreasing its production. After all, if demand increases above what was planned, how many companies would simply keep on producing at the budgeted level and let orders go unfilled? Most companies would strive to meet the increased demand with increased production. So revenues would be higher than planned because of the increased volume, and so would costs. And if demand were to decrease, revenue and costs would also decline.

Since variances due to volume variations are expected, it does not make much sense to continue reporting them on the variance report as causes of variances. It is more important to focus on variances caused by other factors. For example, a variance caused by an increase in the cost of direct labor above what is expected for the **actual** sales could signal a problem in production and should be investigated. But an increase in the cost of direct labor above what is expected for the **budgeted** sales and that is caused by increased production is not a production problem, **if** the cost of the direct labor per unit is equal to the budgeted amount per unit for the number of units **actually sold**.

If sales decline below the planned level, of course, the decline does need to be addressed, and a flexible budget will not be useful for pinpointing a decline in sales below what planned. A comparison between actual sales, variable costs and contribution margin and the master budget sales, variable costs and contribution margin still needs to be done. For that reason, a flexible budget cannot replace a static budget. Most companies that use flexible budgeting also have their managers report on the variances between the master (static) budget and the flexible budget, because those are the variances that are due to volume variations.

In determining what variances should be investigated, the following factors should be considered:

- 1) **The magnitude of the variance.** This will vary depending on the size of the budget line item. A \$1,000 variance would represent 80% of an item where the budgeted amount is \$1,250. But a \$1,000 variance is only 0.10% of a budgeted amount of \$1,000,000.
- 2) **The trend of the variance over time.** If an unfavorable variance has been ongoing for several months and getting larger, then it needs to be investigated, even if its magnitude is not large.
- 3) **The likelihood that an investigation will eliminate future occurrences of the variance.** This is a cost-benefit determination. If an investigation would not result in any changes that could eliminate future occurrences of the variance, then the benefit to be gained from investigating the variance would not be worth the cost of the investigation.

A flexible budget prepared **in addition to** the master budget that is used exclusively for reporting on variances other than those due to sales volume differences allows management to focus on the variances that may be caused by production or administrative problems that need attention. A flexible budget takes the variable revenues and costs as they are planned in the master budget and adjusts the master budget amounts to what the budgeted amounts would have been if the actual sales volume had been used in preparing the budget.

Note that in a flexible budget, **only the variable revenues and costs are adjusted**, because only variable revenues and costs change with changes in sales volume. Fixed costs are fixed costs, and they do not change with changes in sales volume. Therefore, fixed costs in the flexible budget are exactly the same as the fixed costs in the static budget.

Flexible budgeting and use of a standard costing system go together. One is not meaningful without the other.

Here is an example of actual results alongside the static budget (the master budget) and the flexible budget prepared for the actual volume:

	<u>Actual Results</u>	<u>Static Budget</u>	<u>Flexible Budget</u>
Units sold	20,000	24,000	20,000
Revenues	\$2,500,000	\$2,880,000	\$2,400,000
<i>Variable costs</i>			
Direct materials	1,243,200	1,440,000	1,200,000
Direct manufacturing labor	396,000	384,000	320,000
Variable manufacturing overhead	<u>261,000</u>	<u>288,000</u>	<u>240,000</u>
Total variable costs	<u>1,900,200</u>	<u>2,112,000</u>	<u>1,760,000</u>
Contribution margin	<u>599,800</u>	<u>768,000</u>	<u>640,000</u>
Fixed costs	<u>570,000</u>	<u>552,000</u>	<u>552,000</u>
Operating income	<u>\$ 29,800</u>	<u>\$ 216,000</u>	<u>\$ 88,000</u>

This flexible budget will now be used along with the static budget for the period's variance reporting. The only difference between the static budget and the flexible budget is the volume used to calculate variable revenues and expenses. The static budget is prepared for a planned sales volume of 24,000 units, whereas the flexible budget is prepared for a planned sales volume of 20,000 units, which is the actual number of units sold. The variable revenue and cost items in the flexible budget have been adjusted downward for the sales that were lower than planned. But note that the budgeted fixed cost amount is the same in the flexible budget as it is in the static budget.

For each variable revenue and cost, the static budget amount has been divided by the static budget volume of 24,000 to find the budgeted per unit revenue/cost, and that per unit revenue/cost is multiplied by the actual number of units sold – 20,000 – to calculate the flexible budget amount. The fixed cost static budget amount of \$552,000 has been simply carried over to the flexible budget column unchanged.

The flexible budget can be prepared only **after the end of a period**, when the actual sales volume for the period is known. Therefore, a flexible budget would be prepared for each month or each quarter, as well as for the year-end but only when the actual volume for that period is known.

We will talk more about flexible budgets in the section on Performance Management (Variances).

Other Types of Budgets

Project Budgeting

As the name suggests, a project budget is a budget for a specific project. As such, the time frame of the budget may be very short or more long-term, depending upon the length of the project. 0

Project budgets are fundamentally different from the master budget and the flexible budget. The master budget or the flexible budget covers a distinct time span, such as the month of January. In contrast, a project budget covers an identifiable project that has its own time span. That time span may be as little as a week or it may be as long as several years. The focus in project budgeting is on one separate project. Examples of projects that might be budgeted for separately are capital budgeting projects such as the purchase of a new machine or construction of a new plant. Or, a project may be the development and testing of a new product, acquisition of another company, a marketing plan for entering a new geographical area, or a budget for a long-term contract.

Projects must be planned over their entire life spans and should be viewed as special commitments. Their budgeted amounts must be integrated into the master budget of the company for the relevant period or periods.

When developing a project budget, it is critical to include all of the costs that will be required for the project. Though this seems very obvious, it is critical in the identification of indirect costs and overheads that will be allocated to the project.

A long-term project budget for the introduction of a new product can also be called a **life-cycle budget**. A life-cycle budget is one that budgets incomes and expenses for one specific product throughout its entire life cycle — from development through its decline. This enables a company to see the cash flows that will result from the product over its entire life. Additionally, the life-cycle budget allows the company to set a price that will cover not only the production costs, but also the development costs by identifying all of the costs associated with this product.

Activity-Based Budgeting

Activity-based budgeting is similar in concept to activity-based costing, which is covered in the section on Cost Management in this text. Activity-based budgets are prepared based on the resource consumption and related costs to perform the budgeted activities. Activities that drive the costs are identified, a budgeted level of activity for each of these drivers is determined based on a budgeted level of production, and budgeted amounts are developed based on the budgeted level of activity. In an activity-based budget system, there is a clear relationship between resource consumption and output. The advantage of this is that when changes are made to products, product design, product mix, manufacturing processes, etc., managers are able to examine the effects of the changes on budgeted resource demands and on the costs of input resources.

The process of preparing an activity-based budget brings out information about opportunities for cost reductions and elimination of wasteful activities. Thus, activity-based budgeting makes it possible to identify and enhance high value added activities and to eliminate low value added activities and enables continuous improvement.

If activity-based costing is used as the costing system, then the budget should also be activity-based not only to enable continuous improvement, but also to make comparisons between actual results and budgeted results possible. Activity-based budgeting is an extension of the company's activity-based costing system and uses the same activity cost pools to group costs as the activity-based costing system uses.

However, before using the current year's activity cost pools to develop the next period's budget, a firm needs to review its activity pools and the costs going into each for their continued appropriateness and accuracy. Some of the factors may change before the future budget period begins, and data from the current ABC system may need to be updated. This will be especially true if variances during the current or previous periods have been significant. For example, new equipment may have been acquired that has decreased setup time per batch and/or supervisory time during setup or production.

Zero-Base Budgeting

Typically, budgets are developed by starting with the current actual or current budgeted figures and adjusting them for the coming period. This process assumes that the budget period will be similar to the current period. The focus is on things that are expected to change during the coming year. This is an **incremental** approach to budgeting.

Zero-base budgeting is different. Under zero-base budgeting the budget is prepared **without any reference to, or use of, the current period's budget and the likely operating results for the current period**. Though zero-base budgeting is more time consuming and difficult for the people involved, there are a number of advantages to the company as a result of using this method.

Because the budget is built up from zero, each manager must justify all of the expenses in his or her department. This is preferable to the incremental approach of simply taking the current year's actual results and adjusting them up or down for any anticipated changes in the coming year because it enables the company to identify expenses that are not value-adding or that should be reduced due to some development in production methods or something similar.

Note: With incremental budgeting, we assume that the actual results from the current period are acceptable for future periods.

In zero-base budgeting, all of the activities that a department undertakes are identified and then justified. Only revenues and costs from activities that are justified are included in the budget. Also, because the manager needs to examine every single expenditure and activity within the department, s/he is more likely to develop an alternative and, hopefully cheaper, method of accomplishing the same thing.

The disadvantage to zero-base budgeting is that it can require a nearly impossible amount of work to review all of a company's activities every year. As an alternative, a company could schedule zero-base budgeting on a rotating basis, with only a few different departments or divisions being subject to an in-depth review of their activities each year.

Continuous (Rolling) Budgets

A continuous budget, also called a **rolling budget**, is one that is prepared for a certain period of time ahead of the present. For example, a 1-year continuous budget will be prepared at the end of every month for the next 12 months.

Continuous, or rolling, budgets are discussed in more detail in the topic of "Time Frames for Budgets" in the Budgeting Concepts section of this textbook.

Question 9: The major feature of zero-based budgeting is that it:

- a) Takes the previous year's budget and adjusts for inflation.
- b) Questions each activity and determines whether it should be maintained as is, reduced or eliminated.
- c) Assumes all activities worthy of receiving budget increases to cover increased costs.
- d) Focuses on planned capital outlays for property, plant and equipment.

(CIA Adapted)

Budget Reports

After the budgets are determined and approved, they will be used throughout the year to measure how the actual results compare to the budgeted results. We have referred to the importance of variance reporting throughout this section, but it bears repeating.

A budget variance report does this measurement by comparing the actual item (revenues or expenses or units) with the budgeted amount for the same time period. If the company is ahead of the budget (meaning revenues are higher than budgeted or expenses are lower than budgeted) the company has a **favorable variance**. If the opposite is true, the company has an **unfavorable variance**. Variance analysis is covered in detail in the Performance Management section of this textbook.

If the variances are significant or unexpected, the company must investigate and determine the cause of the variance. Some variances are expected — for instance, if sales are higher than budgeted, then it is only logical that there will be an unfavorable variance in direct materials and direct labor if company uses a fixed (or static) budget for the variance reporting.

However, investigating the causes of unexpected variances is one of the most important steps in the budgeting process. This analysis is part of the **control loop**. The control loop is the process by which the activities of the company are controlled.

The major steps in the control loop are:

- 1) **Establish** the budget, or standards of performance.
- 2) **Measure** the actual performance.
- 3) **Analyze and compare** actual results with the budgeted results (this is the budget report).
- 4) **Investigate** unexpected variances.
- 5) **Devise and implement** any necessary corrective actions.
- 6) **Review and revise** the budget/standards if necessary.

Budgeting Questions

In this section of the Exams, one of the most critical things you will need to do is make budgeting calculations. Though at first these questions are very intimidating, they will become easier as you do more of them. Also, there are three main types of numbers questions and once you become familiar with them, they will become easier.

- 1) One set of calculations that you will need to make is **"What would the flexible budget have been?"** You will be given a set of circumstances and the question will be related to what the flexible budget would have given as the budgeted amount. This calculation is made by multiplying the standard rate by the actual quantity produced, used, or whatever is given the situation.
- 2) There are also a number of questions where you will need to **calculate the number of units that a company needs to produce or purchase within a given time period** (usually a month) in order to meet the demand for that period and the opening beginning inventory required for the next month. These questions are based on the following formula:

$$\begin{aligned} & \text{Units needed for use in the current period} \\ + & \text{Units needed for next month's beginning inventory (ending inventory)} \\ = & \text{Total Units needed this period} \\ - & \text{Units on hand at the start of this period (beginning inventory)} \\ = & \text{Units needed to be made or purchased this period} \end{aligned}$$

What are doing in this formula is essentially looking at the inventory question in 2 parts. The first part is to determine how many units will be needed during the period. Units will be needed either for production or for ending inventory. This is the line "Total units needed during the period". There are two sources of these units of inventory. Either the company will have them in beginning inventory at the start of the period, or they will need to purchase or produce the units. So, the second part of the process calculates how many units will need to be purchased or produced during the period.

- 3) Another type of question may relate to the **amount of cash collected or spent during a period** (again, usually a month). Though these questions are difficult to read, the actual math is not that difficult. The key thing is to make sure you identify how much of the credit sales are collected in the month of the sale, and how much are collected after the month of the sale. The same is true for payables – you need to identify when the cash is actually paid.

Flexible Budgeting Questions

Question 10: RedRock East Company uses flexible budgeting for cost control. RedRock produced 10,800 units of product during March, incurring an indirect materials cost of \$13,000. Its master budget for the year reflected an indirect materials cost of \$180,000 at a production volume of 144,000 units. A flexible budget for March should reflect indirect material costs of:

- a) \$13,975
- b) \$13,500
- c) \$13,000
- d) \$11,700

(CMA Adapted)

Question 11: Based on past experience, a company has developed the following budget formula for estimating its shipping expenses. The company's shipments average 12 lbs. per shipment:

$$\text{Shipping costs} = \$16,000 + (\$0.50 \times \text{lbs. shipped})$$

The planned activity and actual activity regarding orders and shipments for the current month are given in the following schedule:

	<u>Plan</u>	<u>Actual</u>
Sales orders	800	780
Shipments	800	820
Units shipped	8,000	9,000
Sales	\$120,000	\$144,000
Total pounds shipped	9,600	12,300

The actual shipping costs for the month amounted to \$21,000. The appropriate monthly flexible budget allowance for shipping costs for the purpose of performance evaluation would be:

- a) \$20,680
- b) \$20,800
- c) \$22,150
- d) \$20,920

(CMA Adapted)

Question 12: Barnes Corporation expected to sell 150,000 board games during the month of November, and the company's master budget contained the following data related to the sale and production of these games:

Revenue	\$2,400,000
Cost of goods sold	
Direct materials	675,000
Direct labor	300,000
Variable factory overhead	<u>450,000</u>
Contribution	\$ 975,000
Fixed overhead	250,000
Fixed selling/administration	<u>500,000</u>
Operating income	<u>\$ 225,000</u>

Actual sales during November were 180,000 games. Using a flexible budget, the company expects the operating income for the month of November to be:

- a) \$225,000
- b) \$420,000
- c) \$510,000
- d) \$270,000

(CMA Adapted)

Question 13: Butteco has the following costs for 100,000 units of product:

Raw materials	\$200,000
Direct labor	100,000
Manufacturing overhead	200,000
Selling/administrative expense	150,000

All costs are variable except for \$100,000 of manufacturing overhead and \$100,000 of selling/administrative expenses. The total costs to produce and sell 110,000 units are:

- a) \$650,000
- b) \$715,000
- c) \$695,000
- d) \$540,000

(CMA Adapted)

Units to Produce / Purchase Questions

The following information is for the next two Questions: Berol Company, which plans to sell 200,000 units of finished product in July, anticipates a growth rate in sales of 5% per month. The desired monthly ending inventory in units of finished product is 80% of the next month's estimated sales. There are 150,000 finished units in inventory on June 30.

Each unit of finished product requires 4 pounds of direct materials at a cost of \$1.20 per pound. There are 800,000 pounds of direct materials in inventory on June 30.

Question 14: Berol Company's production requirement in units of finished product for the 3-month period ending September 30 is:

- a) 712,025 units.
- b) 638,000 units.
- c) 665,720 units.
- d) 630,500 units.

Question 15: Assume Berol Company plans to produce 600,000 units of finished product in the 3-month period ending September 30, and to have direct materials inventory on hand at the end of the 3-month period equal to 25% of the use in that period. The estimated cost of direct materials purchases for the 3-month period ending September 30 is:

- a) \$2,200,000
- b) \$2,880,000
- c) \$2,640,000
- d) \$2,400,000

(CMA Adapted)

Question 16: The Jung Corporation's budget calls for the following production, in number of units:

Qtr 1 – 45,000 units Qtr 2 – 38,000 Qtr 3 – 34,000 units Qtr 4 – 48,000

Each unit of product requires 3 pounds of direct material. The company's policy is to begin each quarter with an inventory of direct materials equal to 30% of that quarter's direct material requirements. Budgeted direct materials purchases for the third quarter are:

- a) 38,200 pounds.
- b) 89,400 pounds.
- c) 114,600 pounds.
- d) 29,800 pounds.

(CMA Adapted)

The following information is for the next two Questions: Daffy Tunes manufactures a toy rabbit with moving parts and a built-in voice box. Projected sales in units for the next 5 months are as follows:

<u>Month</u>	<u>Projected Sales in Units</u>
January	30,000
February	36,000
March	33,000
April	40,000
May	29,000

Each rabbit requires basic materials that Daffy purchases from a single supplier at \$3.50 per rabbit. Voice boxes are purchased from another supplier at \$1.00 each. Assembly labor cost is \$2.00 per rabbit, and variable overhead cost is \$.50 per rabbit. Fixed manufacturing overhead applicable to rabbit production is \$12,000 per month. Daffy's policy is to manufacture 1.5 times the coming month's projected sales every other month, starting with January (i.e., odd-numbered months) for February sales, and to manufacture 0.5 times the coming month's projected sales in alternate months (i.e., even-numbered months). This allows Daffy to allocate limited manufacturing resources to other products as needed during the even-numbered months.

Question 17: The unit production budget for toy rabbits for January is:

- a) 45,000 units.
- b) 54,000 units.
- c) 16,500 units.
- d) 14,500 units.

Question 18: The dollar production budget for toy rabbits for February is:

- a) \$327,000
- b) \$127,500
- c) \$113,500
- d) \$390,000

(CMA Adapted)

The following information is for the next three Questions: Rokat Corporation is a manufacturer of tables sold to schools, restaurants, hotels and other institutions. Rokat manufactures the table tops, but an outside supplier sells the table legs to Rokat. The Assembly Department takes a manufactured table top and attaches the 4 purchased table legs. It takes 20 minutes of labor to assemble a table. The company follows a policy of producing enough tables to ensure that 40% of next month's sales are in the finished goods inventory. Rokat also purchases sufficient raw materials to ensure that raw materials inventory is 60% of the following month's scheduled production. Rokat's sales budget in units for the next quarter is as follows:

July	2,300
August	2,500
September	2,100

Rokat's ending inventories in units for June 30 are:

Finished goods	1,900
Raw materials (legs)	4,000

Question 19: The number of tables to be produced during August is:

- a) 1,900 tables.
- b) 1,440 tables.
- c) 2,340 tables.
- d) 1,400 tables.

Question 20: Assume the required production for August and September is 1,600 and 1,800 units respectively, and the number of table legs in the July 31 raw materials inventory is 4,200 units. The number of table legs to be purchased in August is:

- a) 2,200 legs
- b) 6,520 legs.
- c) 6,400 legs.
- d) 9,400 legs.

Question 21: Assume that Rokat Corporation will produce 1,800 units in the month of September. How many employees will be required for the Assembly Department? (Fractional employees are acceptable since employees can be hired on a part-time basis. Assume a 40-hour week and a 4-week month.)

- a) 3.75 employees.
- b) 60 employees.
- c) 15 employees.
- d) 600 employees.

(CMA Adapted)

The following information is for the next two Questions: Wellfleet Company manufactures recreational equipment and prepares annual operational budgets for each department. The Purchasing Department is finalizing plans for the fiscal year ending June 30, 2009, and has gathered the following information regarding 2 of the components used in both tricycles and bicycles. Wellfleet uses the first-in, first-out inventory method.

	<u>A19</u>	<u>B12</u>	<u>Tricycles</u>	<u>Bicycles</u>
Beginning inventory, July 1, 2008	3,500	1,200	800	2,150
Ending inventory, June 30, 2009	2,000	1,800	1,000	900
Unit cost	\$1.20	\$4.50	\$54.50	\$89.60
Projected fiscal year unit sales	--	--	96,000	130,000
Component usage:				
Tricycles	2/unit	1/unit	--	--
Bicycles	2/unit	4/unit	--	--

Question 22: The budgeted dollar value of Wellfleet Company's purchases of component A19 for the fiscal year ending June 30, 2009 is:

- a) \$309,000
- b) \$540,600
- c) \$2,017,800
- d) \$538,080

Question 23: If the economic order quantity of component B12 is 70,000 units, the number of times that Wellfleet Company should purchase this component during the fiscal year ended June 30, 2009 is:

- a) Eight times.
- b) Nine times.
- c) Four times.
- d) Five times.

(CMA Adapted)

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Cash Flow Questions

Question 24: DeBerg Co. has developed the following sales projections for the year:

May	\$100,000	August	160,000
June	120,000	September	150,000
July	140,000	October	130,000

Normal cash collection experience has been that 50% of sales are collected during the month of sale and 45% are collected the following month. The remaining 5% of sales is never collected. DeBerg's budgeted cash collections for the third calendar quarter are:

- a) \$450,000
- b) \$440,000
- c) \$414,000
- d) \$360,000

(CMA Adapted)

The following information is for the next two Questions: Information about Noskey Corporation's sales revenue is presented in the following table.

	November (Actual)	December (Budget)	January (Budget)
Cash sales	\$ 80,000	\$100,000	\$ 60,000
Credit sales	<u>240,000</u>	<u>360,000</u>	<u>180,000</u>
Total sales	\$320,000	\$460,000	\$240,000

Management estimates that 5% of credit sales are uncollectible. Of the credit sales that are collectible, 60% are collected in the month of sale and the remainder in the month following the sale. Purchases of inventory are equal to next month's sales and gross profit margin is 30%. All purchases of inventory are on account; 25% are paid during the month of purchase, and the remaining 75% are paid during the month following the purchase.

Question 25: Noskey Corporation's budgeted cash collections in December from November credit sales are:

- a) \$136,800
- b) \$91,200
- c) \$144,000
- d) \$96,000

Question 26: Noskey Corporation's budgeted total cash receipts in January are:

- a) \$294,000
- b) \$239,400
- c) \$299,400
- d) \$240,000

(CMA Adapted)

The following information is for the next two Questions: The Raymar Company is preparing its cash budget for the months of April and May. The firm has established a \$200,000 line of credit with its bank at a 12% annual rate of interest on which borrowings for cash deficits must be made in \$10,000 increments. There is no outstanding balance on the line of credit loan on April 1. Principal repayments are to be made in any month in which there is a surplus of cash. Interest is to be paid monthly. If there are no outstanding balances on the loans, Raymar will invest any cash in excess of its desired end-of-month cash balance in U.S. Treasury bills. Raymar intends to maintain a minimum balance of \$100,000 at the end of each month by either borrowing for deficits below the minimum balance or investing any excess cash. Monthly collection and disbursement patterns are expected to be:

- Collections: 50% of the current month's sales budget and 50% of the previous month's sales budget.
- Accounts Payable Disbursements: 75% of the current month's accounts payable budget and 25% of the previous month's accounts payable budget.
- All other disbursements occur in the month in which they are budgeted.

Budget Information

	<u>March</u>	<u>April</u>	<u>May</u>
Sales	\$40,000	\$50,000	\$100,000
Accounts payable	30,000	40,000	40,000
Payroll	60,000	70,000	50,000
Other disbursements	25,000	30,000	10,000

Question 27: In April, Raymar's budget will result in:

- \$45,000 in excess cash.
- A need to borrow \$50,000 on its line of credit for the cash deficit.
- A need to borrow \$100,000 on its line of credit for the cash deficit.
- A need to borrow \$92,500 on its line of credit for the cash deficit.

Question 28: In May, Raymar will be required to:

- Borrow an additional \$30,000 principal and pay \$1,000 interest.
- Repay \$90,000 principal and pay \$100 interest.
- Pay \$900 interest.
- Borrow an additional \$20,000 and pay \$1,000 interest.

(CMA Adapted)

Forecasting Techniques

Forecasting and Budgeting

One of the most important parts of the planning and budgeting process is the identification of the assumptions that a company must make about the future. Since planning and budgeting involve looking into the future, the company must make some assumptions about the outlook for the environment in which its business operates. These assumptions are called **premises**. When identifying premises, it is essential that management focus only on those that will actually impact the potential success of their business. By focusing on premises that are not a critical part of the organization's success, management is wasting valuable company time and resources.

Some premises will affect the whole company, whereas some premises will not. Different departments will have different premises because of the unique tasks they face. The finance department may be concerned about the expected interest rate, but the interest rate will not impact the production department in the fulfillment of its objectives. However, the rate of growth (or rate of contraction) in the economy and the rate of inflation (or deflation) expected during the budget period will probably impact planning and budgeting for nearly every area of the organization.

This section covers forecasting techniques that can be used to develop budgeted amounts that are based on premises. Once the premises have been identified and quantified, the forecasting can be done.

Mathematical models are commonly used in forecasting. A mathematical model is an equation that attempts to represent an actual situation. For example, if a company has a product that it sells for \$1,000 each, and if we use R to represent total revenue, the total revenue that the company will earn by selling x units can be represented by the following equation, or mathematical model:

$$R = 1,000x$$

For a model to be useful, it must be a good representation of the real situation. Therefore, it is important to carefully construct the equations.

Collecting the Data for a Forecast

In forecasting, historical data is used in various ways. We may look at the past to discover a pattern for use in predicting the future. Or we may look at the past relationship between two factors to determine if there has been a cause-and-effect relationship between them that can be used to predict future results. Collecting the data is usually the most difficult step in analysis. When working with costs, one of the primary challenges is finding the **cost driver** that best fits the data – in other words, the **causal factor** in the cause-and-effect relationship.

Thus, there are **two basic forecasting methods**:

- 1) **Time series methods**, which look only at the historical pattern of one variable and generate a forecast by extrapolating the pattern using one or more of the **components** of the time series, and
- 2) **Causal forecasting methods**, which look for a cause-and-effect relationship between the variable we are trying to forecast (the **dependent variable**) and one or more other variables (the **independent variables**).

Time Series Analysis

Note: This is the first of two basic forecasting methods. The other is Causal forecasting and it is covered after this section on Time Series Analysis.

Time series data reflects activity for **one variable** – an organization, plant, activity, or one expense classification – over a sequence of past time periods. A **time series method of forecasting** uses only these historical values in an attempt to find a pattern in them that can be used in forecasting the future. Only one

set of historical time series data is used in time series analysis and that historical data is not compared to any other set of data.

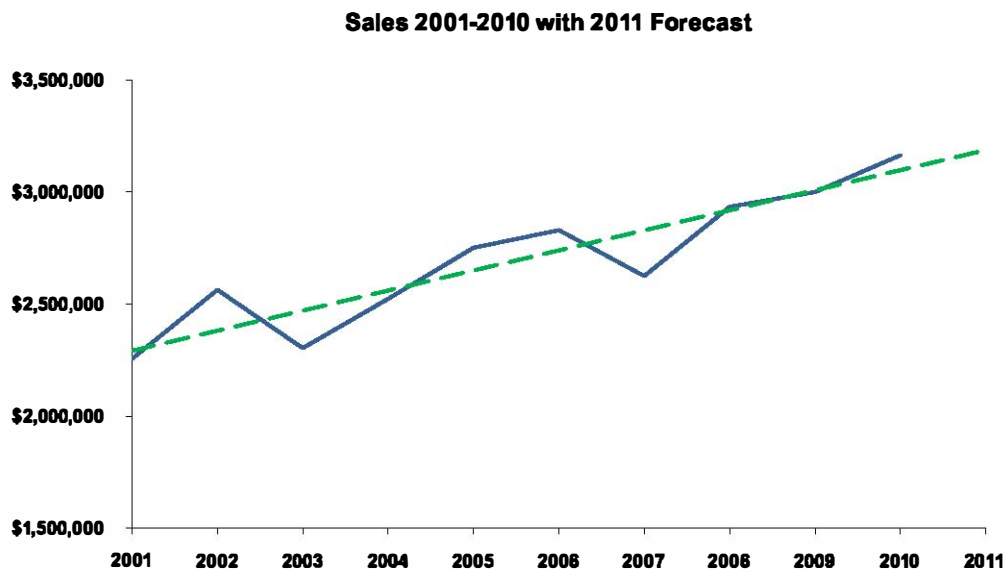
Time series analysis looks at patterns of the desired variable over time. These patterns from the past are then used to forecast a future result. A time series may have one or more of four **patterns** (also called components) that influence its behavior over time:

- 1) **Trend**
- 2) **Cyclical**
- 3) **Seasonal**
- 4) **Irregular**

Note: In addition to these patterns of behavior, time series data can also be affected by **inflation**. The presence of inflation can distort the analysis, and it may be necessary to adjust the time series or the resulting forecast to remove this distortion. Inflation is discussed in more detail later in the material.

1. Trend Pattern

Over a long period of time, the historical data may exhibit a **trend**, which is a gradual shifting to a higher or lower level. If a long-term trend exists, there will probably still be short-term fluctuations within that trend; however, the long-term trend will be apparent. For example, sales from year to year may fluctuate but overall, they may be going up, as is the case in the graph below.



The long-term sales trend has been upward from 2001 to 2010, despite the dips in 2003 and 2007. According to this trend, a reasonable sales forecast for 2011 would be \$3,250,000.

Trends in a time series analysis are not always upward and linear like the above graph. Time series data can exhibit an upward linear trend, a downward linear trend, a nonlinear (curved) trend or no trend at all. A scattering of points that have no relationship to one another would represent no trend at all.

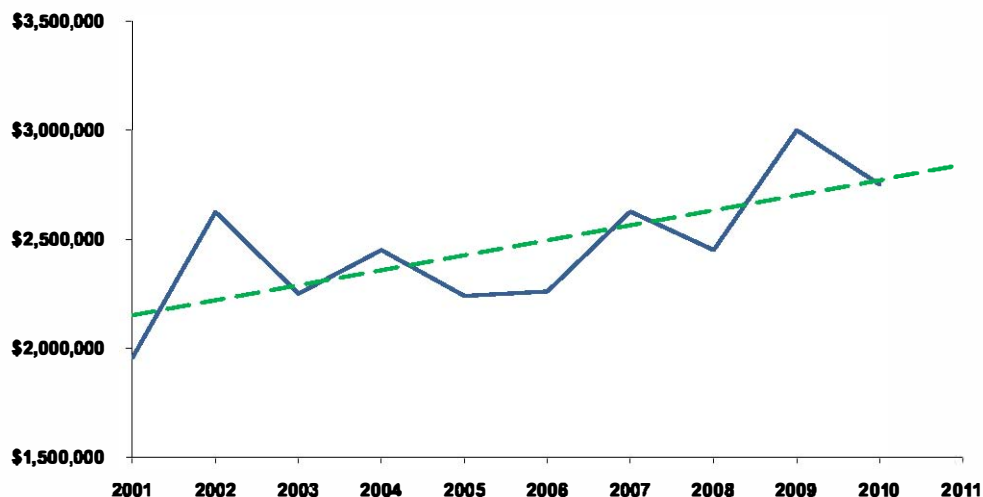
A trend pattern is analyzed using **simple regression analysis**. Simple regression analysis is covered later in the material.

2. Cyclical Pattern

A long-term trend line can still be established even if the sequential data fluctuates greatly from year to year due to cyclical factors. Any recurring fluctuation that lasts longer than one year is attributable to the **cyclical component** of the time series. The cyclical component is usually due to the cyclical nature of the economy.

In the graph below, we see an example of the cyclical components of a time series. The fluctuations from year to year are greater than they were for the first graph. However, we can still see a long-term trend.

Sales 2001-2010 with 2011 Forecast



3. Seasonal Pattern

In order to identify trend and cyclical components of a time series, we track the annual historical movements of the data over several years. That is, we look only at results for full years, such as total sales for the years 2001 through 2010.

However, a time series can fluctuate within the year due to seasonality in the business. For example, a swimsuit company's sales would be highest during the warm summer months, whereas a retailer of skis would experience its peak sales in the wintertime. Variability in the time series due to seasonal influences is called the **seasonal component**.

"Seasonal" behavior can take place within any time period that is less than a year in length. A business that has its busiest time of day at the same time every day is said to have a **within-the-day seasonal component**. As long as the pattern repeats regularly, it is a seasonal component.

4. Irregular Pattern

A time series can also vary in a random pattern, not repeating itself in any regular pattern. This is called the **irregular pattern**. It is caused by short-term, nonrecurring factors, and its impact on the time series cannot be predicted.

Using Time Series Analysis in Forecasting

The objective of time series analysis is to develop a forecast for future results. Time series methods are used in forecasting in two ways:

- 1) **Smoothing** (moving averages, weighted moving averages and exponential smoothing), and
- 2) **Trend projection (including trends adjusted for seasonal influence).**

We will now look at each of these in more detail.

1. Smoothing

Just as the name implies, smoothing methods attempt to "smooth out" random fluctuations caused by the **irregular component** of a time series. Smoothing methods work with a time series that has **no significant trend, cyclical or seasonal effects**. They do not work well when there is a long-term upward or downward trend or when there is cyclical variation or seasonal variation. However, when nothing affects the values except random variations, smoothing methods can provide highly accurate, short-range forecasts such as a forecast for the next time period.

Moving Averages

Note: This is the first of three smoothing methods.

Moving averages use the average of the most recent data in the time series. Whenever a new value becomes available for the time series, it replaces the oldest value. For example, when using a four-week moving average to forecast sales, to forecast sales for week five, we would average the sales for weeks one through four. The forecast of sales for week ten would use the average sales for weeks six through nine. This method assumes that each of the values used (in this case, the previous four weeks of sales) are of equal value in predicting future results. While this may be the case, it may also be that the more recent values are more indicative of future results than the results from longer ago periods.

Weighted Moving Average

Note: This is the second of three smoothing methods.

A weighted moving average is a variation of the moving average method. When utilizing this method, we use different **weights** for each value and compute a weighted moving average, using the most recent data in the time series. For example, we might give more recent historical values weights that are greater than those given to the older values. If there are four months of data, to forecast the fifth month's value using a weighted moving average, we would approach it in the manner outlined in the following example.

Example: ABC Corporation wants to use a four-month weighted moving average method to forecast sales for the month of May. Actual sales for ABC for the months of January, February, March and April are as follows:

January	\$21,000,000
February	23,000,000
March	25,000,000
April	20,000,000

ABC has assigned a descending weight to each month's values, starting with the most recent month. Each of the month's results is multiplied by the weight, and then these individual monthly values are added together to determine the May forecast. The weights ABC has assigned to the four previous months are 40%, 30%, 20% and 10%. This means that the results in the most recent month (April) will have four times the impact on the May forecast as the oldest month (January).

			<u>Weight</u>		
April	\$20,000,000	×	4/10	=	\$ 8,000,000
March	25,000,000	×	3/10	=	7,500,000
February	23,000,000	×	2/10	=	4,600,000
January	21,000,000	×	1/10	=	<u>2,100,000</u>
					<u>\$22,200,000</u>

Note that the total of all the weights equals 10/10, or 1.

The weighted moving average is the total, **\$22,200,000**, and this is the expected result for May.

Note: The accuracy of the weighted moving average will depend on the weights that are given to the previous periods. If the weights are 'correct', the resulting forecast will be accurate. A company can use past results and make calculations using different weights for the different periods in order to find out what weights have been the most accurate in the past. However, this provides information only about the past. Any changes in the business, its environment or operations may cause the weightings to need to be changed.

Exponential Smoothing

Note: This is the third of three smoothing methods.

Exponential smoothing is a special type of weighted moving average. With exponential smoothing, we forecast a value for the next period by calculating a weighted average of two numbers only:

- 1) The most recent period's **actual** value, and
- 2) The most recent period's **forecasted** value, as calculated using exponential smoothing.

Exponential smoothing takes the forecast developed for the most recent period and adjusts it up or down based on what actually occurred in that period. Both the previous month's forecasted and actual values are given a weight. The expected and actual values from the previous month are multiplied by their weights and the two numbers added together becomes the forecast for the next period.

The amount of weight put on the actual value is called **alpha** (α), or the **smoothing constant**. It will always be between 0 and 1. The amount of weight put on the forecasted value will be $(1 - \alpha)$. The total weight put on both values will always equal 1.

The setting of the value of **alpha** is the most important step in this process. If **alpha** is set to 1, the forecast for the next period will be based completely upon the actual value from the current period, with no weight given to the forecasted value from the current period. If **alpha** is set to 0, the actual value from the current period will be completely ignored and all the weight will be put on the forecasted value. Neither of these will provide much information for the future. That is why **alpha** will always be between 0 and 1. Usually **alpha** will be between 0 and .4.

We will discuss how **alpha** is determined and why its value is between 0 and .4, but first we will look at the calculation of a forecasted value for the coming month, using the current month's actual and forecasted values. We are using the same actual data used to calculate a forecast based on a weighted moving average in the previous example. However, forecasted amounts that have been calculated using exponential smoothing are added to the table.

Example: In January, ABC Corporation began using exponential smoothing to forecast sales for each month. Actual and forecasted sales, in millions, for ABC for the months of January, February, March and April are as follows. Forecasted sales for January through April have been calculated using exponential smoothing and an **alpha** of .1.

	<u>Actual (Y)</u>	<u>Forecasted* (F)</u>
January	\$21.0	N/A
February	23.0	\$21.0
March	25.0	21.2
April	20.0	21.6

*Forecasted by means of exponential smoothing.

To calculate a sales forecast for the month of May using exponential smoothing, use only the **actual sales for the month of April** and the **forecasted sales (forecasted using exponential smoothing) for the month of April**.

As you may have noticed, the forecasted value was calculated using exponential smoothing. This is a requirement. For exponential smoothing to work, the forecasted value used can **only** be one that was calculated using exponential smoothing.

The calculation is expressed algebraically as follows:

$$F_{t+1} = \alpha Y_t + (1 - \alpha) F_t$$

Where:

- F_{t+1} = forecast for the next period
- Y_t = actual value for period t
- F_t = forecasted value for period t
- α = smoothing constant (between 0 and 1)

The forecasted sales figure for the month of May will be:

$$F_{t+1} = (.1 \times 20) + (.9 \times 21.6)$$

$$F_{t+1} = \underline{\underline{21.4}}$$

The forecast ultimately becomes a weighted average of all the previous actual values because during each period, the next period's forecast is calculated by using the current period's actual and forecasted values. That current period's forecast is calculated using the previous period's data, which used data from the period before that, and so on. And yet, only the current period's actual and forecasted values are required to calculate this historical weighted average.

When exponential smoothing to calculate the next period's forecast is first instituted, more weight is automatically given to the very earliest period's results. This heavy weighting will decrease period by period as several periods pass and more history builds up. Ultimately, the greatest weight will be on the most current period's results with the weight descending as the results go back in time. (This can be proven mathematically but is outside the scope of the exam and so is not presented.) At all times, the sum of the weights for all the periods will be 1.0.

One of the advantages of exponential smoothing is that it does not require a lot of historical data. Therefore, it is an inexpensive method to use when multiple forecasts need to be made every period. If using a moving average or a weighted moving average method, we would have to apply several different historical values, but exponential smoothing requires only the current period's actual and forecasted values. Thus, data storage requirements are minimized.

Exponential smoothing is a simple concept, yet it is quite powerful because of its weighting process.

On the other hand, a disadvantage of exponential smoothing is that its forecast will lag behind as the trend increases or decreases over time. And it does not account for dynamic changes that occur in actual practice. Its forecasts will require constant updating in order to respond to new information.

Furthermore, in exponential smoothing, the choice of α is important, because it influences the accuracy of the resulting forecast. The desirable value for α is one that minimizes the forecasting error over time. The forecasting error is calculated by taking the historical difference between the actual and the forecasted values using exponential smoothing. That difference, or **error**, for each period, is then squared to eliminate negative amounts, and the squared error amounts for each period are averaged. This average is called the **Mean Squared Error** or **MSE**. Our goal is to find a value for α that will minimize the MSE. The calculation of the best *alpha* can be made by using historical data and determining what value of *alpha* provides the lowest MSE.

Note: Detailed information about the calculation of MSE is outside the scope of the exam and is therefore not included here. You only need to know that the MSE is the measure of the error in the exponential smoothing, and that it should be minimized.

Generally, as *alpha* increases, the forecasting error decreases, **up to an *alpha* of .4**. When *alpha* increases beyond .4, not much improvement results relative to the amount of the increase. For that reason, *alpha* is usually between 0 and .4.

However, if the **actual values fluctuate substantially and randomly**, we prefer a **lower** value for α , because we do not want to adjust forecasts too much in response to random variations. In this case a larger *alpha* will create a **greater** MSE and a **less** accurate forecast because a larger *alpha* will cause more weight to be put on the random variations.

For this reason, exponential smoothing as a forecasting technique is most useful when the time series is stable, without many fluctuations.

As additional time series data is collected, the smoothing constant α can be adjusted for future forecasts at any time.

Note: Smoothing methods are useful for a **stable time series** that has no significant trend, cyclical, or seasonal effects.

2. Trend Projection and Regression Analysis

When a time series is increasing or decreasing consistently, smoothing methods are not appropriate for forecasting. Instead, a time series that has a long-term upward or downward trend can be forecasted by means of **trend projection**. A trend projection is done with **simple regression analysis**, which forecasts values using information from all available observations.

Simple linear regression analysis relies on two assumptions:

- Variations in the dependent variable (i.e., what we are forecasting) are **explained by variations in one single independent variable** (i.e., the passage of time, if a time series is what we are forecasting).
- The relationship between the independent variable (time or something else) and the dependent variable (sales or whatever we are forecasting based on the value of the independent variable) is **linear**. A linear relationship is one that will graph as a straight line.

The line of best fit, as determined by **simple linear regression**, is a formalization of the way we would fit a line just by looking at it. To fit a line by looking at it, we would use a ruler and move it until we think we have **minimized the differences** between the points and the line we would draw with the ruler. This will usually be a straight line located approximately at the place where the same number of points are above the line as are below it.

Similar to fitting a line visually, the goal in linear regression analysis is to take each of the differences between the individual values and the point on the regression (trend) line for that time period – called a **deviation** – square each deviation, then calculate the total of all the squares of the deviations; and have the result be as low as it can get. When this is the case, the total of the squares of the deviations is “minimized,” and the trend line is the “line of best fit.” That line can then be used for forecasting using extrapolation.

To use regression analysis, we first graph the values of the time series and review the results. If the long-term trend appears to be linear, we can use **simple regression analysis** to determine the trend value.

Before actually using regression analysis for a forecast, however, we should perform **correlation analysis** to determine the **strength of the linear relationship between the value of X and the value of Y** in order to determine whether trend projection would be meaningful. Correlation analysis measures the relationship between two or more variables. This measurement shows how closely connected the variables are and the extent to which a change in one variable will result in a change in the other.

Note: The X axis on the graph is the horizontal axis and the Y axis is the vertical axis. The X axis represents the independent variable, and the Y axis represents the dependent variable. In a time series regression analysis, the passage of time is the independent variable and is on the X axis.

The **coefficient of correlation**, represented by the letter **R** or **r** is a numerical measure that measures both the direction (positive or negative) and the strength of the linear association. In linear regression analysis using only one variable such as sales, the period of time serves as the independent variable – on the x axis– while the sales level serves as the dependent variable – on the y axis.

When a time series such as sales over a period of several years is graphed, the data points on the graph may show an upsloping linear pattern, a downsloping linear pattern, a nonlinear pattern (a curve) or no pattern at all. The pattern of the data points indicates the amount of **correlation** between the values on the x axis (time) and the values on the y axis (sales). This amount of correlation, or **coefficient of correlation, r** , is expressed as a number between -1 and $+1$.

- A correlation coefficient, r , of **+1** means there is a perfect **positive** (upsloping) linear relationship between each value for x and its corresponding value for y .
- A correlation coefficient, r , of **-1** means there is a perfect **negative** (downsloping) linear relationship between each value for x and its corresponding value for y .
- A coefficient of correlation, r , which is **close to zero**, usually means there is no, or very little, relationship between the variables. However, in some cases it may mean that there is a strong relationship, but it is not a linear one (you do not need to know how to recognize this, but just be aware that it may occur).
- If the coefficient of correlation, r , is a positive number **close to +1**, such as .83, this indicates that the data points follow a linear pattern fairly closely, and the pattern is upsloping (i.e., sales are increasing).
- If the coefficient of correlation, r , is a negative number **close to -1**, such as $-.77$, this would indicate that the data points follow a linear pattern, although less closely than in the previous example, and the pattern is downsloping instead of upsloping (i.e., sales are decreasing).

The coefficient of correlation, r , does nothing to tell us **how much** of the variation in the independent variable is explained by changes in the dependent variable. It tells us only whether there is either a direct (upsloping) or inverse (downsloping) relationship between the variables and how strong that relationship is.

Note: It is important to first **look at** the plotted data points on the graph when determining whether there is a relationship between the two variables. Do not rely on the value of the coefficient of correlation to tell you whether or not there is a relationship between the two variables, because the coefficient of correlation will not detect non-linear relationships.

The coefficient of correlation, r , can be used to determine whether trend projection would be meaningful.

- A high correlation coefficient, r , (i.e., a number close to either $+1$ or -1) would indicate that simple linear regression analysis would be useful as a way of making a projection using a trend line.
- A low correlation coefficient, r , (close to 0) would indicate that a forecast made using simple regression analysis would not be very meaningful.

Note: The coefficient of correlation, r , can be **calculated in Excel** by entering the X values in one column (say Column A, rows 1-10), the Y values in another column (say Column B, Rows 1-10), and entering the following formula in a blank cell:

`=CORREL(A1:A10,B1:B10)`

The statistical method used to perform simple regression analysis is called the **Least Squares**, also known as the **Ordinary Least Squares** method, or **OLS**. If we call the **predicted value** of y obtained from the fitted line " $\hat{y}$," then the prediction equation, or the equation of a linear regression line is:

$$\hat{y} = ax + b$$

Where:

$\hat{y}$ = the *predicted* value of y on the regression line corresponding to each value of x

a = the slope of the line

b = the y intercept, or the value of y when x is 0

x = the value of x on the x axis that corresponds to the value of y on the trend line.

Note: This formula may be written in different ways, but x will always represent the independent variable and y is the constant. The **coefficient of the independent variable**, or the **variable coefficient**, is whatever term is next to the x in the formula. This might be an a , as in the equation above, or the a and the b might be reversed and b might be next to the x . But regardless of which letter is next to the x , that term represents the **amount of increase in y for each unit of increase in x** , or the **slope** of the line.

The **constant coefficient** is b in the equation above, and it represents the y intercept because this is the value of y when x is zero. The equation might also use a as the constant coefficient. The right side of the equation may present the terms in any order, too. The constant coefficient may come first.

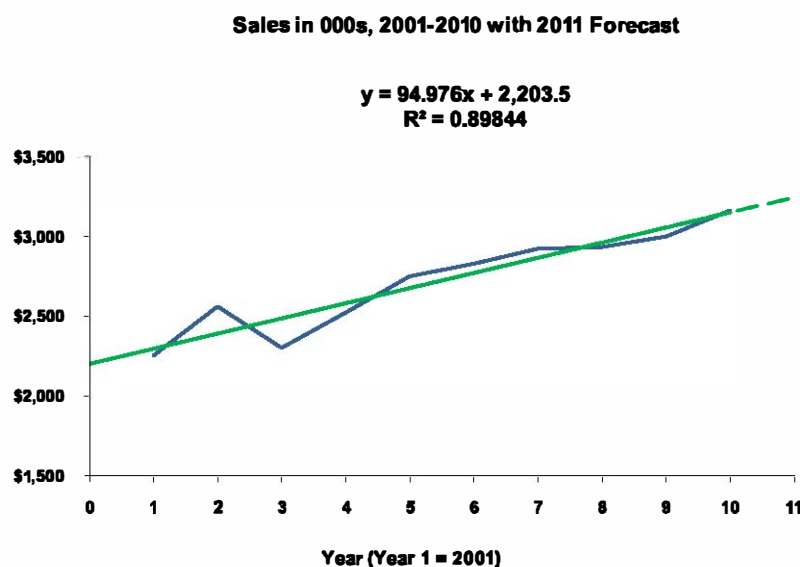
This equation, $\hat{y} = a + bx$ is exactly the same as this equation, $\hat{y} = ax + b$.

In the second equation, the coefficients are reversed and the order of the terms on the right side of the equation are reversed.

Just remember to **look for the x** . The term next to it will be the variable coefficient, or the amount of increase in y for each unit of increase in x ; and the term that is all by itself will be the constant coefficient and is the y intercept, or the value of y when x is zero.

The symbol over the y in the formula is called a "hat", and thus, it is read as "y-hat." It means that we are looking at the **predicted value**, not at the actual value.

Here is a graph that illustrates a regression analysis. We have made a couple of changes so that the trend line, the equation of the trend line, and the **coefficient of determination, R^2 or r^2** , (more later on that) can be calculated on the computer. We have expressed sales in thousands and changed the years along the x axis to Year 1, Year 2, etc., to enable computer calculation.



The **coefficient of correlation, r** , as calculated in Excel for this regression, is .94786. It is a positive number because the trend line is upsloping. If the trend line were downsloping, the coefficient of correlation, r , would be a negative number. A value close to 1 (or -1), which .94786 is, indicates that there is a close correlation between the values of x and the values of y on this graph. And in fact, you can see that when you look at the graph. Thus, in this case, regression analysis is a good method of forecasting sales for coming years.

The **equation of the trend line**, as calculated on the graph above, is:

$$y = 94.976x + 2,203.5$$

This means that the trend line starts at 2,203.5, and each value on the trend line increases 94.976 over the previous year's trend line value. Thus for each year, the trend of sales has increased by \$94,976.

Forecasted sales for 2011, according to this regression equation, are:

$$y = 94.976x + 2,203.5$$

$$y = (94.976 * 11) + 2,203.5$$

$$y = 3,248.236 \text{ (or \$3,248,236)}$$

And that is consistent with the point on the y axis where we see the extension of the trend line when it is lined up with 11 on the x axis.

Question 29: Correlation is a term frequently used in conjunction with regression analysis, and is measured by the value of the coefficient of correlation, r . The best explanation of the value r is that it

- a) Is always positive.
- b) Interprets variances in terms of the independent variable.
- c) Ranges in size from negative infinity to positive infinity.
- d) Is a measure of the relative relationship between two variables.

(CMA Adapted)

Question 30: What coefficient of correlation results from the following data?

X	Y
1	10
2	8
3	6
4	4
5	2

- a) 0
- b) -1
- c) $+1$
- d) Cannot be determined from the data given.

(CIA Adapted)

Question 31: As part of a risk analysis, an auditor wishes to forecast the percentage growth in next month's sales for a particular plant using the past 30 months' sales results. Significant changes in the organization affecting sales volumes were made within the last 9 months. The most effective analysis technique to use would be

- a) Unweighted moving average.
- b) Exponential smoothing.
- c) Queuing theory.
- d) Linear regression analysis.

(CIA Adapted)

Other Measures Used in Regression Analysis Forecasting

In addition to the coefficient of correlation, r , several other measures are used to evaluate the precision and reliability of a regression forecast. These would be performed either at the same time as or following the actual regression analysis:

- The **size of the standard error (SE) of the estimate** must be interpreted in relationship to the average size of the dependent variable. Hence, the units of the error may seem large (i.e. 10,000 units), but in comparison to the size of the variable (100,000,000 units), that percentage of error would be small. If the standard error of the estimate is around 5-10% or less of the average size of the dependent variable, we can be confident that the regression analysis is fairly precise.

SE aids in establishing a confidence interval around the forecasted value. This range of confidence at 95%, 97% or 99% tells the likelihood that the random variable x can be found within the defined interval. The higher the percentage of confidence (99%), the higher the assurance that the value will fall into the range. However, the precision of the forecast suffers because of the broader range of values that are in the range of possible results.

- The **coefficient of determination** is the square of the coefficient of correlation. It is represented by the term R^2 , or r^2 , and it is the **percentage of the total amount of change in the dependent variable that can be explained by changes in the independent variable**.

R^2 is expressed as a number between 0 and 1. In a regression with a high r^2 , the data points will all lie close to the trend line. In a regression with a low r^2 , the data points will be scattered above and below the trend line. An r^2 above .50 would indicate that the forecast yielded by simple linear regression analysis should be meaningful.

In the above example, r^2 , the coefficient of determination, is $.94786^2$, or .8984. Note that if the trend line were downsloping and the coefficient of correlation were $-.94786$, for example, the coefficient of determination would still be .8984, since squaring eliminates the negative value. While coefficient of correlation (r) *indicates* the strength of the relationship between two variables, coefficient of determination (r^2) *actually measures* that strength.

Inflation Adjustment in a Time Series Analysis

When working with a time series, especially one that covers a long period of time, the data can be distorted by the presence of inflation during that period. For instance, when working with sales growth over a ten-year period, the sales that occurred each year will contain an additional component representing the increase in the cost of that good simply as a result of inflation.

We need a way to remove the portion of the sales each year that is attributable to price movements, leaving us with the change in the quantity of sales. This will provide us with **inflation-adjusted** sales figures and an **inflation-adjusted** sales forecast.

Before we look at this process, we first need to understand some definitions:

- The **nominal** data is the data in the time series measured in the dollars that were current at the time each data point was captured. These dollars are affected by inflation.
- **Real** data is the inflation-adjusted time series data, with the effects of inflation removed.
- In order to convert nominal data to real data, we need an appropriate **price index** that expresses the rate of inflation. The Consumer Price Index, the Producer Price Index, the Personal Consumption Expenditure Index and the GDP Deflator are all commonly used as expressions of the inflation rate in the United States (and other countries will have essentially the same measures, though the names may be different). A price index measures the value of a basket of goods at a certain time relative to the value of the same basket in a base period. The price index is calculated by dividing the value of the basket in the year we are interested in by that same basket's value in the base year. That ratio is then multiplied by 100.

When working with a time series, the price index figures for all years are "reindexed" to set the base year's index to 100 and express each subsequent year's index in terms of the base year index. This is done by dividing each year's price index by the base year's price index and multiplying by 100. Then, to calculate the **real** values in a time series for a particular year, we take the **nominal** values and divide each one by its reindexed price index in decimal form.

(See Example C in the pages following.)

Formulas:

$$\text{Real Value} = \frac{\text{Nominal Value}}{\text{Current Price Index} / \text{Previous Year's Price Index}}$$

OR

$$\text{Real Value} = \frac{\text{Nominal Value}}{1 + \text{Inflation Rate}}$$

Example A: First, we will use last year as the base year. Assume that the Consumer Price Index this year is 151 and last year it was 149. In this case, the rate of inflation is 1.3%. This is calculated with the following formula: $[(151/149) - 1]$, or $[1.013 - 1.000] = .013$.

If the nominal value of sales for this year is \$1,000,000, then to calculate the Real Value of sales for this year in terms of last year, we will divide \$1,000,000 by 151/149, which is 1.013, the reindexed price index in decimal form. This is also 1 + the inflation rate.

$$\text{Real Value} = \frac{\$1,000,000}{1.013} = \$987,167$$

Now let's use a period further back in time as the base year one, and we will say the Consumer Price Index was 120 at that time. We will divide the nominal sales of the current period by 151/120, which is 1.258:

$$\text{Real Value} = \frac{\$1,000,000}{1.258} = \$794,913$$

When making forecasts, of course, we are not working with **this** year's inflation rate but rather with the **expected** inflation rate for the future year we are forecasting. So to determine next year's real sales forecast, simply divide next year's nominal sales forecast by 1 + the expected inflation rate.

Example B: We anticipate that the expected inflation rate for next year will be 1%. Sales this year totaled \$100,000,000. Based on forecasts from the marketing department, we are anticipating **nominal** sales growth of 10% next year. However, since that is nominal sales growth, the 10% figure includes the effect of inflation. The production department needs to know what that means in actual quantity of increased sales, so they can prepare for it. What do we forecast that **real** sales will be next year?

Step 1: Nominal sales next year (including inflation) are expected to be $\$100,000,000 \times 1.10 = \$110,000,000$.

Step 2: In order to calculate real sales for next year (anticipated) the nominal sales need to be divided by the $(1 + \text{inflation rate})$: $\$110,000,000 \div 1.01 = \$108,910,891$.

So **real** sales (taking out the effect of inflation) will be \$108,910,891.

Step 3: To calculate the **real rate of sales growth**, divide real sales next year by actual sales this year and subtract 1.0 from it, as follows:

$$\text{Real rate of sales growth} = \frac{\$108,910,891}{\$100,000,000} - 1.0 = .089 \text{ or } \underline{8.9\%}$$

Or, we can calculate the real rate of sales growth using only the nominal rate and the inflation rate, as follows:

$$\text{Real rate} = \frac{1 + \text{Nominal Rate}}{1 + \text{Inflation Rate}} - 1.0$$

In the above example the real rate of sales growth, calculated this way, is:

$$\text{Real rate of sales growth} = \frac{1.10}{1.01} - 1.0 = .089 \text{ or } \underline{8.9\%}$$

Note that 8.9% is **not the same** as 10% minus the 1% inflation rate. It is not much different, but it is different.

Furthermore, if we have the **real** rate and the **inflation** rate, we can find the **nominal** rate, using these equations as follows:

$$\begin{aligned} &[(\text{Real rate} + 1) \times (\text{Inflation rate} + 1)] - 1 = \text{Nominal rate} \\ &[(.089 + 1.000) \times (.01 + 1.000)] - 1 \\ &= (1.089 \times 1.01) - 1 \\ &= 1.10 - 1 = .10 \end{aligned}$$

To deflate several years of time series sales figures to the base year values, start by dividing each year's price index by the price index of the base year to get a "reindexed" price index for each year. Then divide the nominal sales figure for each year by its reindexed price index to get the real sales in terms of the base year.

Example C: Here are sales figures for 10 years, deflated to the base year of 2000. Note that the first year's price index is not 100; but when we reindex, we **make** the first year's reindexed price index equivalent to 100.

Year	Nominal Sales (in 000s)	CPI	Reindexed	Decimal	Real Sales (in 000s)
2000	2,256	115.6	100.0 ^(a)	1.000	2,256
2001	2,564	117.1	101.3 ^(b)	1.013	2,531 ^(c)
2002	2,305	119.3	103.2	1.032	2,234
2004	2,525	121.4	105.0	1.050	2,405
2005	2,752	123.1	106.5	1.065	2,584
2006	2,830	125.4	108.5	1.085	2,608
2007	2,926	127.8	110.6	1.106	2,646
2008	2,935	129.8	112.3	1.123	2,614
2009	3,001	131.5	113.8	1.138	2,637
2010	3,165	132.8	114.9	1.149	2,755

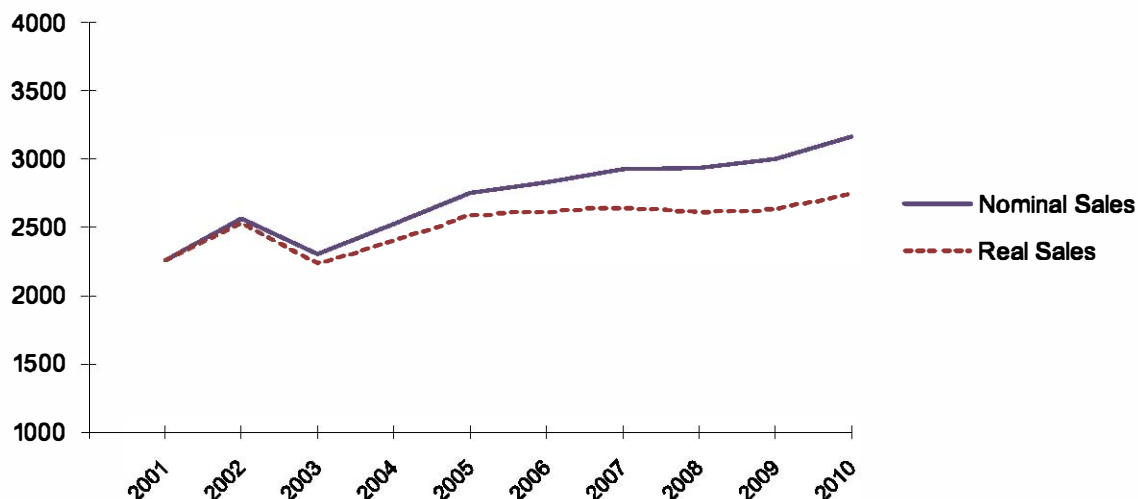
(a) $(115.6 \div 115.6) \times 100$

(b) $(117.1 \div 115.6) \times 100$

(c) $2,564 \div 1.013$

When the sales data is "deflated," as above, we see that real sales growth has not been as great as nominal sales growth. The two sales lines on the graph below illustrate the difference. Note that the difference becomes greater with each passing year. That is because the inflation adjustments are cumulative, since we are expressing sales for each year in terms of the **base year**, not in terms of the year previous to it.

Sales in 000s, 2001-2010



Causal Forecasting

Note: This is the second of two basic forecasting methods. The other is Time Series Analysis and it was just covered.

Causal forecasting methods are used when the value that we are forecasting can be determined to be affected by some other value. If we can identify a **cause and effect relationship** between what we are forecasting and the other value, and if that relationship is a linear one, we can use a projection of the other value (the independent variable) to forecast the value we are interested in (the dependent variable).

Note: The two basic assumptions of simple regression analysis are:

- 1) Changes in the value of the dependent variable can be explained by changes in the level of the independent variable; and
- 2) The **relationship** between the dependent variable and the independent variable is **linear**. That is, a graph of the two variables, with the independent variable on the x-axis and the dependent variable on the y-axis, will result in a straight line within the relevant range.

For example, if we know that the level of sales is directly related to the level of advertising, we can forecast sales once we know the future level of advertising. Therefore, once the advertising budget has been set, we can use planned advertising expenditures to forecast sales.

How do we know whether or not there is a relationship between advertising expenditures and sales? We use regression analysis, as described in the preceding section. The only difference is that instead of using years or another time period as the independent variable, we use advertising expenditures during each year or quarter as the independent variable.

We use historical data on advertising expenditures (on the x axis, the independent or predictor variable) and sales (on the y axis, the dependent or response variable), graph it and do correlation analysis to determine whether there is a linear relationship between the two variables.

Multiple Regression Analysis in Forecasting

If we have only one independent variable and one dependent variable and the relationship between them is linear, regression analysis is called **simple linear regression**, just as it was called in the section above. However, it is also possible for one dependent variable (for example, sales) to be affected by **more than one** independent variable (for example, advertising expenditures, size of the sales staff, competition, the economy and any number of other possible causes). When there is more than one independent variable, the regression analysis is called **multiple regression analysis**.

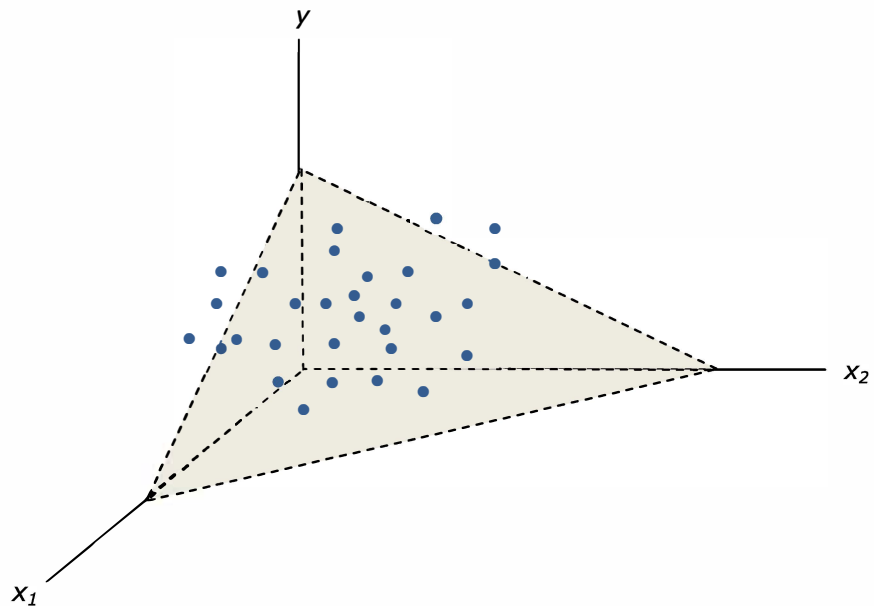
When we use one or more values to forecast another value that is influenced or explained by the first value(s), we are doing **causal forecasting**. When doing causal forecasting, we can use time series data, such as advertising expenditures over time. However, time series data is not always available. When time series data is not available, regression analysis can still be employed to develop a causal forecast.

For example, demographic data may be used to forecast sales for a new retail store that is being planned. If we have previously opened new outlets in other areas, we can use demographic data from those areas and relate it to sales results in the new retail store. The size of the population, the population's socio-economic level, age breakdown, and many other factors can be tried as independent variables in relating actual sales levels experienced in other areas to demographic information for those areas. If we find a linear relationship or relations **that are causal**, we can then use that demographic information for the new area to forecast its sales levels.

If we find **several** demographic factors that are good predictors, we can use them in a **multiple regression analysis**.

Note: In order to use regression analysis, there must be a reasonable basis to expect the dependent variable to be caused by the independent variable. If there is no reason for a connection, any connection found through the use of regression analysis is accidental. **So we must be careful not to assume that a linear relationship means there is a cause and effect relationship.**

The simple regression analysis we illustrated previously was in a single geometric plane. The graph of a multiple regression analysis will have three or even more dimensions – a dimension, or x axis, for each independent variable. Here is an illustration of a multiple regression analysis with two independent variables and two x axes, x_1 and x_2 :



The equation of this three-dimensional multiple regression function is:

$$\hat{y} = a_1x_1 + a_2x_2 + b$$

Where:

$\hat{y}$ = the *predicted* value of y on the regression line corresponding to each value of x_1 and x_2

a_1, a_2 = variable coefficients, similar to the slope of the line

b = the constant coefficient, the y intercept, or the value of y when x_1 and x_2 are 0

x_1 = the value of x on the x_1 axis that corresponds to the value of y on the trend line

x_2 = the value of x on the x_2 axis that corresponds to the value of y on the trend line

As in simple regression, this formula may be written in different ways. In fact, it usually uses either all "a"s or all "b"s, with a subscripted zero (0) to indicate the constant coefficient. We have presented it as above in order to be consistent with the way the simple regression function was presented earlier. However, it is frequently represented as follows:

$$\hat{y} = a_0 + a_1x_1 + a_2x_2$$

Where a_0 is the constant coefficient and it appears at the beginning instead of at the end.

Or as:

$$\hat{y} = b_0 + b_1x_1 + b_2x_2$$

Where b_0 is the constant coefficient and it appears at the beginning instead of at the end.

It could also be written as:

$$\hat{y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

Where β_0 is the constant coefficient and it appears at the beginning instead of at the end.

The constant coefficient usually appears at the beginning of the right side of the equation for a multiple regression analysis function (instead of at the end as we show the equation for a simple regression analysis), because there could be an infinite number of independent variables. To indicate that infinite number of independent variables, the equation would be written like the one below. This uses "b"s for all of the variables, although "a"s could also be used:

$$\hat{y} = b_0 + b_1 x_1 + b_2 x_2 + \dots + b_k x_k$$

Again, look for the x terms and for the term without an x. The x terms will be the variable coefficients and the term without any x will be the constant coefficient.

Evaluating the Reliability of a Multiple Regression Analysis

If you recall, in our discussion of simple regression analysis, we said that the **coefficient of determination**, r^2 , is the percentage of the total amount of change in the **dependent** variable that can be explained by changes in the **independent** variable. Thus, r^2 is an indicator of the reliability of a simple regression analysis. If it is above .50, it means that the regression is fairly reliable, because the regression can be used to predict that percentage of the total variation in the dependent variable. The higher the r^2 is, the better, of course.

R^2 is used as an indicator of the reliability of a multiple regression analysis, too. However, multiple regression analysis uses another indicator as well. It is called the **t-value** – actually t-values (plural).

The r^2 and the t-values are calculated by computer and they are based on the input supplied for the independent variables and the dependent variable. The r^2 value evaluates the whole regression, including all of the independent variables used. A separate t-value is calculated for each of the individual independent variables in the multiple regression.

The **t-values measure the reliability of each independent variable**, which is the degree to which each independent variable has a valid, long-term relationship with the dependent variable. The t-value for each independent variable evaluates the **contribution** of that independent variable to the multiple regression analysis. **The t-value for every independent variable used in a multiple regression should generally be greater than 2.** A value below 2 indicates little or no relationship between the independent variable and the dependent variable and thus, that independent variable should not be used for causal forecasting in a multiple regression.

Before using each independent variable in the multiple regression analysis, each one should be evaluated by doing an individual simple regression analysis for **each** independent variable being considered. Examine the output for each, particularly the **coefficient of correlation r** and the **coefficient of determination r^2** . This will be similar to the information we used when we were when working with one variable (sales) over time. However, now we will be using a **value** for each independent variable – rather than simply using time –to identify a relationship or lack of relationship between it and the dependent variable.

If this is done **before running the multiple regression** and if only those independent variables that are highly correlated with the dependent variable are used in the multiple regression, the t-values that result from the multiple regression should all be good – greater than 2. If, however, one or more of the t-values are below 2, then those independent variables need to be eliminated and the multiple regression run again. This is true even if the r^2 for the whole regression is high, for example .85.

Note: Remember in doing correlation analysis that correlation does not prove causation. There must be a logical cause and effect relationship in addition to a high correlation in the data.

If the coefficient of determination, or r^2 , is only .50 for a multiple regression analysis (which is low but acceptable), the multiple regression might still be used to predict 50% of the variation in the dependent variable, **if the t-values for all the independent variables are good (greater than 2)**.

The Error Term in Causal Forecasting

In causal forecasting, we discuss further the concept of the **error term** in regression analysis. For the purposes of this discussion, we will refer only to the simple regression analysis equation, although the error term is also a factor in multiple regression.

Remember that the equation of the trend line, or the line of "best fit" on the sales graph, was:

$$\hat{y} = ax + b$$

This equation, which is the simple linear regression model, gives us the **average** value of y , the response, for a given value of x , the predictor. The **average** response is a line. However, the actual observed data has responses that are not on the line itself, but rather are **scattered around this line**. This scatter is often called the **error**. It is represented by the Greek letter *epsilon*, or ϵ . The *epsilon* in the following model represents the scatter of the data around the line. If there were no error term, all of the data would fall on the regression line.

In algebra, when writing an equation such as $y = 300x + 2000$, it means that y is exactly that. However, with regression data, it means that this is true **on average** but not true for a given value of x .

So the equation for a **given value of x** is as follows:

$$y = ax + b + \epsilon$$

where: y = the **dependent** variable

a = the slope of the line, or the amount of change in y as a result of one unit of change in x ; this is called the variable coefficient

b = the Y intercept of the line

x = the **independent** variable

ϵ = the **error term** of the equation, which is the distance between the regression line and any particular data point

This model makes the following assumptions:

- 1) The relationship between x and y is linear.
- 2) The error term is normally distributed and has a value close to 0.
- 3) The variance of the error term, i.e., the distribution of y around the regression line, is constant for all the values of the independent variable x .
- 4) Errors in different samples are not related and are statistically independent from each other.
- 5) The independent variable is uncorrelated with the error term.

The inclusion of an error term in the regression model has the following effects:

- 1) It recognizes that the regression model is imperfect. That is, some variables that help to "explain" the behavior of the dependent variable might not be included.
- 2) The included variables may have been measured with error.
- 3) There is always some component in the variation of the dependent variable that is completely random.

Benefits and Limitations of Regression Analysis

The benefits or advantages of regression analysis are:

- Regression analysis is a quantitative method and as such, it is objective. A given data set generates a specific result. That result can be used to draw conclusions and make forecasts.
- Thus, regression analysis is an important tool for use in budgeting and cost accounting. In budgeting, it is virtually the only way to compute fixed and variable portions of costs that contain both fixed and variable components (**mixed costs**).

The shortcomings or limitations of regression analysis are:

- To use regression analysis, historical data is required for the variable that we are forecasting or for the variables that are causal to this variable. If historical data is not available, regression analysis cannot be used.
- Even when historical data is available, if there has been a significant change in the conditions surrounding that data, its use is questionable for predicting the future.
- In causal forecasting, the usefulness of the data generated by regression analysis depends upon the choice of independent variable(s). If the choice of independent variable(s) is inappropriate, the results can be misleading.
- The statistical relationships that can be developed using regression analysis are valid only for the range of data in the sample.

Question 32: In regression analysis, which of the following correlation coefficients represents the strongest relationship between the independent and dependent variables?

- a) 1.03
- b) $-.02$
- c) $-.89$
- d) $.75$

(CIA Adapted)

The following information is for the next Two Questions: In preparing the annual profit plan for the coming year, Wilkens Company wants to determine the cost behavior pattern of the maintenance costs. Wilkens has decided to use linear regression by employing the equation $y = a + bx$ for maintenance costs. The prior year's data regarding maintenance hours and costs, and the results of the regression analysis are as follows.

Average cost per hour	\$9.00
a	684.65
b	7.2884
Standard error of a	49.515
Standard error of b	.12126
Standard error of the estimate	34.469
r^2	.99724

	<u>Hours of Activity</u>	<u>Maintenance Costs</u>
January	480	\$4,200
February	320	3,000
March	400	3,600
April	300	2,820
May	500	4,350
June	310	2,960
July	320	3,030
August	520	4,470
September	490	4,260
October	470	4,050
November	350	3,300
December	<u>340</u>	<u>3,160</u>
Sum	<u>4,800</u>	<u>\$43,200</u>
Average	400	\$3,600

Question 33: Based upon the data derived from the regression analysis, 420 maintenance hours in a month would mean the maintenance costs (rounded to the nearest dollar) would be budgeted at:

- a) \$3,780
- b) \$3,600
- c) \$3,790
- d) \$3,746

Question 34: The percentage of the total variance that can be explained by the regression equation is:

- a) 99.724%
- b) 69.613%
- c) 80.982%
- d) 99.862%

(CMA Adapted)

Learning Curves

Learning curves describe the fact that the more experience people have with something, the more efficient they become in doing that task. Higher costs per unit early in production are part of the start-up costs. It is commonly accepted that new products and production processes experience a period of low productivity followed by increased productivity. However, the rate of productivity improvement declines over time until it reaches a level where it remains, until another change in production occurs.

Learning curve analysis is used in planning, budgeting and forecasting and also to determine costs when bidding on a contract.

There are two learning-curve models:

- Cumulative Average-Time Learning Model
- Incremental Unit-Time Learning Model

Cumulative Average vs. Incremental Unit Model

The **Cumulative Average-Time Learning Model** evaluates the **average** time per unit required to produce **all** of a given number of units produced **to date**. The **Incremental Unit-Time Learning Model** evaluates the time needed to produce the **last unit** in a quantity of units.

Cumulative Average-Time Learning Model

The Cumulative Average-Time Learning Model uses a constant percentage of decline in **average time per unit** each time that the **cumulative** (i.e., accumulated total, or total to date) quantity of units produced doubles.

In other words, if a plant that manufactures automobiles is subject to an 80% learning curve, and if the time required to build the **first** automobile is 10 hours, then the **total time** required to manufacture **the first 2** autos will be 80% of (10 hours $\times$ 2), or 16 hours, which equates to an **average of 8 hours** for each of the two automobile built to date. Note that this model measures **total** time required, which includes the time for the first unit, and uses that total time to determine **average time per unit** for the entire amount produced. This is what "cumulative average" means.

If learning had not taken place, the time required to produce 2 autos would have been 20 hours (2 $\times$ 10 hours). Thus, a learning rate of 1.00 or 100% is equivalent to **no learning taking place**. However, because learning did take place and the learning curve was 80%, the time required to produce the first auto was 10 hours, and the time required to produce the second auto was 6 hours, for a total of 16 hours for both. The **cumulative average** was 8 hours for each auto.

The maximum learning rate is 50%, or .50, because at a rate of 50%, the total time required for production of 2 autos would be equal to the time required to produce the first auto (10 $\times$ 2 $\times$.5). Even 50% is an improbable rate. But lower than 50% is an impossible rate, because it is impossible to produce 2 autos in less time than it took to produce the first auto. Therefore, **the learning rate will always be between 50% and 100%**.

Learning rates are developed by analyzing historical data. The method used to analyze the data may be the high-low points method or a regression analysis. The high-low points method and use of regression analysis are covered and illustrated in Section C of this book under the topic "Estimating Fixed Costs."

Example: Given a 90% learning curve, the following data about productivity may apply:

<u>Number of units</u>	<u>Cumulative average time per unit, minutes</u>
100	5
200	4.5 (5×90%)
400	4.05 (4.5×90%)

Question: What is the average time per unit required for the second 100 units?

Solution: The first 100 units took $100 \times 5 = 500$ minutes to produce. The first 200 units took $200 \times 4.5 = 900$ minutes to produce. So, the average time per unit required for the second 100 units is $(900 \text{ minutes} - 500 \text{ minutes}) \div 100 \text{ units} = \underline{4 \text{ minutes}}$.

Example: The cost accountant for Ray Lighting Manufacturing Company is planning production costs for a new lamp. Production of the new lamp will be subject to a 60% learning curve, since it involves only minimal adjustments to established processes. The initial lot of 500 lamps is expected to require 1,000 hours of labor. Costs are as follows:

Direct Labor	\$20/hr.
Direct Materials	\$50/DLH
Variable OH Applied	\$25/DLH
Fixed OH Applied	\$2,000/lot manufactured

(1) What is the cumulative average time per unit after 8 lots have been manufactured, if the cumulative average-time model is used?

Answer: With a 60% learning curve, when the quantity of units produced doubles, the cumulative average time per unit for the doubled number of units is 60% of the cumulative average time per unit for the original number of units.

In this case, we are working with lots of 500 rather than units. However, the question asks for average time **per unit**, and there are 500 units in each lot.

The first doubling will occur when the second lot of 500 has been produced. The second doubling will occur when the fourth lot of 500 has been produced. The third doubling will occur when the eighth lot of 500 has been produced.

Therefore, the **total** number of labor hours required for 8 lots of 500 lamps is:

$$1,000 \times (2 \times .60) \times (2 \times .60) \times (2 \times .60) =$$

$$1,000 \times 1.2 \times 1.2 \times 1.2 = 1,728 \text{ total labor hours required for 8 lots.}$$

Next, we calculate **the average** number of labor hours required **per lot** for 8 lots, and then we can determine the average number of labor hours **per unit** for 8 lots.

$$1,728 \text{ total labor hours required} \div 8 \text{ lots} = \text{average of 216 labor hours per lot.}$$

Average 216 labor hours per lot $\div$ 500 lamps per lot = .432 cumulative average number of labor hours required **per lamp** for 8 lots of 500 lamps each.

(2) What is the total cost for the eighth lot?

Answer: To determine an **incremental** cost under the cumulative average-time learning model, set up a chart such as the following:

Cum # of Lots		Cum Avg Time/Lot	=	Cum Tot Time	Cumulative Cost		Addition to Cum. Cost
1	x	1,000	=	1,000	$(\$95 \times 1,000)^{(a)} + (\$2,000 \times 1)^{(b)} =$	\$97,000	\$97,000
2	x	600	=	1,200	$(\$95 \times 1,200) + (\$2,000 \times 2) =$	\$118,000	21,000
4	x	360	=	1,440	$(\$95 \times 1,440) + (\$2,000 \times 4) =$	\$144,800	26,800
8	x	216	=	1,728	$(\$95 \times 1,728) + (\$2,000 \times 8) =$	\$180,160	35,360

Addition to Cumulative Cost is the cumulative cost of the total number of lots manufactured. The total number of lots manufactured is in the first column. Here, that is \$118,000 after the second lot. Subtract the previous cumulative cost, and you will have the cost of only Lot 2.

The Addition to Cumulative Cost for Lots 3 and 4 (the third doubling) is \$144,800 minus \$118,000, or \$26,800. Since there are 2 lots (Lots 3 and 4) that have cost a total of \$26,800, the cost of each lot is 1/2 that amount. Thus, Lot 3 costs \$13,400 and Lot 4 costs \$13,400.

The total cost for the **final 4 lots** (Lots 5, 6, 7 and 8) is \$35,360, which is \$180,160 minus \$144,160. Thus, the total cost for just the eighth lot is 1/4 of that, or \$8,840.

- (a) \$95 is the total variable cost per DLH: \$20 for direct labor, \$50 for direct materials, and \$25 for variable overhead applied. 1,000 is the number of hours required to manufacture the first lot. After 2 lots have been manufactured (the first doubling), the average time per lot will be 60% of 1,000 hours, or 600 hours, so the cumulative total time will be (600 hours $\times$ 2), or 1,200 hours.
- (b) \$2,000 is the fixed overhead applied per lot. Multiply the fixed overhead applied per lot by the number of lots (in column 1).

Incremental Unit-Time Learning Model

The Incremental Unit-Time Learning Model states that the time needed to produce the **last unit** (Incremental unit time) declines by a **constant percentage** each time the cumulative quantity of units produced doubles.

For example, we will look at the same automobile manufacturing plant, which is subject to an 80% learning curve rate and requires 10 hours to build the **first** automobile. If the learning curve is 80% and the Incremental Unit-Time Learning Model is used, the time required to manufacture **the second** auto will be 80% of 10 hours, or 8 hours. Thus, the total time required to produce two autos is 10 hours + 8 hours, or 18 hours. And the **average time** per unit will be $18 \div 2$, or 9 hours.

Under the same assumptions for both models, the Incremental Unit-Time Model will predict a higher cumulative total time (and thus a higher average time per unit) to produce two or more units than the Cumulative Average-Time Model. The choice of which model to use should be based on which one more accurately predicts the behavior of labor hour usage as production levels increase.

By using the Incremental Unit-Time Learning Model, it is possible to calculate the amount of time that will be required to produce the **last** unit of each group of doubled units (i.e., the 2nd, 4th, 8th and 16th units, etc.) without using a financial calculator.

However, in order to determine the time required to produce the 3rd, 5th, 6th or 7th units, and the 9th through 15th units, etc., one would need a financial calculator because the time required will decline with each individual unit produced. Since financial calculators are not required for the Exam, such a calculation would be outside the scope of the Exam.

To calculate the time required to produce the last unit, simply multiply the time required for the first unit by the % of the learning curve for each time that the production doubles.

Example: Let us assume that it requires 12 hours to produce the 1st unit, and there is an 80% learning curve. To determine the production time for the 2nd unit we simply multiply 12 by .8. In order to determine the time required to produce the 4th unit we have $12 \times .8 \times .8$. The time for the 8th unit will be calculated as $12 \times .8 \times .8 \times .8$, and so on for the 16th, 32nd and incremental units. Note that these times that we have calculated are for only the 2nd, 4th, 8th, 16th ... units as this method calculates the time to produce the last unit each time that production doubles.

Following is the Ray Lighting Manufacturing example once again, this time using the Incremental Unit-Time Learning Model to calculate the items that can be calculated without a financial calculator.

Example: The cost accountant for Ray Lighting Manufacturing Company is planning production costs for a new lamp. The lamp will be subject to a 60% learning curve since it involves only minimal adjustments to established processes. The accountant expects the initial lot of 500 lamps to require 1,000 hours of labor. Costs are as follows:

Direct Labor	\$20/hr.
Direct Materials	\$50/DLH
Variable OH Applied	\$25/DLH
Fixed OH Applied	\$2,000/lot manufactured

Question: What is the time required to produce the 8th lot, using the Incremental Unit-Time Learning Model?

Answer: With a 60% learning curve, each time the quantity of units produced doubles the time required to produce the **last** unit is 60% of the time that was required to produce the **last** unit of the previous production level.

In this case, we are working with lots of 500 rather than units, so the 8th lot is the last unit of that doubling level. Therefore, the time required to produce the 8th lot of 500 is:

$$1,000 \times .60 \times .60 \times .60 = \underline{216 \text{ hours.}}$$

Unlike the Cumulative Average Time Learning Model, it is **not possible to use the Incremental Unit-Time Learning Model to determine the total number of hours** that would be required to produce the entire 8 lots without a financial calculator. This is because it is not possible to calculate the amount of time required for the 3rd lot or for the 5th, 6th and 7th lots without a financial calculator.

Question: What is the total cost for the 8th lot?

Answer: To determine the cost of the 8th lot under the Incremental Unit-Time Learning Model, we take the 216 hours required for the 8th lot calculated above, and multiply it by the \$95 total variable cost per hour to get a total variable cost of \$20,520. Since fixed overhead applied is \$2,000 per lot, we add \$2,000 of fixed cost to the \$20,520 variable cost to get the total cost for the 8th lot of \$22,520.

Note that this is the total cost for **only the 8th lot**, since it is not possible to determine the total cost for the entire 8 lots without a financial calculator.

On an Exam, you may be asked for the time or the cost required for the final unit in a production process where production levels are doubling. If you are not told whether to use the Incremental Unit-Time Learning Model or the Cumulative Average-Time Learning Model, try working it out both ways to see if you can reach one of the answer choices provided by the Exam. You will probably be able to calculate the time and cost of the final unit faster by using the Incremental Unit-Time Learning Model instead of the Cumulative Average-Time Learning Model, so try it that way first.

Benefits of Learning Curve Analysis

Decisions such as the following can be aided by learning curve analysis:

- 1) Make or buy decisions – the analysis of the cost to make will be affected.
- 2) Life-Cycle costing – in calculating the cost of a contract, learning curve analysis can ensure that the cost estimates are accurate over the life of the contract, leading to better bidding.
- 3) Cost-Volume-Profit analysis – in determining a breakeven point. If learning is not considered, the result may be overstatement of the number of units required to break even.
- 4) Development of standard costs – labor costs should be adjusted regularly in recognition of the fact that learning causes standard costs to change over time.
- 5) Capital budgeting – costs can be projected more accurately over the life of the capital investment when expected improvements in labor productivity due to learning are included.
- 6) Development of production plans and labor requirements – production and labor budgets should be adjusted to accommodate learning curves.
- 7) Management control – recognizing that higher costs will occur in the early phase of the product life cycle allows more effective evaluation of managers.

Limitations of Learning Curve Analysis

There are three limitations and problems associated with learning curve analysis:

- 1) Learning curve analysis is **appropriate only for labor-intensive operations involving repetitive tasks** where repeated trials improve performance. If the production process is designed to have fast set-up times using robotics and computer controls, there is little repetitive labor and thus little opportunity for learning to take place.
- 2) The **learning rate is assumed to be constant**. In real life, the decline in labor time might not be so constant. It might be that the learning rate would decline at the rate of 70% for the first 75,000 units, followed by 80% for the next 50,000 units and 95% for the next 25,000 units.
- 3) The reliability of a learning curve calculation can be jeopardized because **an observed change in productivity might actually be associated with factors other than learning**, such as a change in the labor mix, or the product mix or other factors. In this situation, a learning model developed using this historical data would produce inaccurate estimates of labor time and cost.

Question 35: The average labor cost per unit for the first batch produced by a new process is \$120. The cumulative average labor cost after the second batch is \$72 per product. Using a batch size of 100 and assuming the learning curve continues, the total labor cost of four batches will be:

- a) \$4,320
- b) \$10,368
- c) \$2,592
- d) \$17,280

(CMA Adapted)

The following information is for the next Two Questions: Moss Point Manufacturing recently completed and sold an order of 50 units that had costs as follows.

Direct materials	\$ 1,500
Direct labor (1,000 hours x 8.50)	8,500
Variable overhead (1,000 hours x \$4.00)*	4,000
Fixed overhead**	<u>1,400</u>
	<u>\$15,400</u>

*Applied on the basis of direct labor hours.

**Applied at the rate of 10% of variable cost.

The company has now been requested to prepare a bid for 150 units of the same product.

Question 36: If an 80 percent learning curve is applicable, Moss Point's total cost on this order would be estimated at:

- a) \$26,400
- b) \$31,790
- c) \$37,950
- d) \$38,500

Question 37: If Moss Point experienced a 70 percent learning curve, the bid for 150 units would:

- a) Show a 30 percent reduction in the total direct labor hours required with no learning curve.
- b) Include increased fixed overhead costs.
- c) Be 10 percent lower than the total bid at an 80 percent learning curve.
- d) Include 6.40 direct labor hours per unit at \$8.50 per hour.

(CMA Adapted)

Probability

There are many events in business and nature for which it is impossible to exactly predict the outcome. However, the probability of the occurrence of an event can be described quantitatively (numerically) if the same event occurs a great number of times under finite conditions. For example, it is impossible to predict with 100% certainty whether a fair coin will turn up as "heads" or "tails" in one particular toss of the coin. But if we toss that coin many times, we can conclude that the number of "heads" will be very close to 50% of the total number of flips of the coin.

Probability gives us a means of measuring numerically how likely it is that an event will occur. Probability is used in forecasting and budgeting to create an **expected value** for an element that needs to be forecasted, such as future cash flows. The expected value is used in the budget.

Probability is always expressed as a value between 0 and 1, and that is usually converted to a percentage between 0% and 100%. The closer the probability is to 0, the less likely it is that the event will occur; a probability of 0 (or 0%) means there is no chance that the event will occur. Conversely, a probability near 1 tells us that the event is almost certain to occur, and a probability of exactly 1 (or 100%) would mean it is absolutely certain to occur. Other probabilities between 0 and 1 give us various chances of an event occurring. When a weather forecaster tells us there is a 40% probability of rain today, it gives us some idea of whether we need to carry an umbrella.

Two Requirements of Probability

When the weather forecaster says there is a 40% probability that it will rain today, it also implicitly means there is a 60% probability that it **won't** rain. This illustrates the **two basic requirements of probability**:

- 1) The probability values assigned to **each** of the possible outcomes must be between 0 and 1; AND
- 2) The probable values assigned to **all** of the possible outcomes must total 1.

Conditional Probability

The **conditional probability** of two events is the probability that the second event will occur when it is known that the first event has already occurred. If we are planning a new product, we may develop expected sales for the first year based on the probabilities of various forecasted sales amounts. For example, it is determined that there is a 30% probability that sales will be \$1,000,000; a 40% probability that sales will be \$700,000; and a 30% probability that the product will not be successful and sales will be only \$200,000. Then, we might develop sales forecast probabilities for Year 2 that depend upon what happens in Year 1. For instance, *if* sales are \$1,000,000 in Year 1, we may determine that there is a 40% probability that sales will be \$1,500,000 in Year 2; a 40% probability that sales will remain even at \$1,000,000 in Year 2; and a 20% probability that sales will go down to \$750,000 in Year 2.

Joint Probability

Joint probability is the probability of two or more events all occurring together. The joint probability of two independent events is calculated as the probability of the first event multiplied by the probability of the second event.

If the occurrence or nonoccurrence of one event does not change the probability of the occurrence of the other event, the two events are said to be **independent**. The probability of two independent events occurring is the independent probability of the first event multiplied by the independent probability of the second event.

The probability that either one or both of two independent events will occur is equal to the sum of their independent probabilities, minus their joint probability. This is useful when we have two possible events, and we want to know the probability that **at least one, and maybe both** of the events will occur.

Note: If the occurrence of one event means that another event cannot occur, the two events are said to be **mutually exclusive**. The probability of one of the mutually exclusive events happening is the chance of each of the events individually added together.

Item	Calculation
Conditional Probability	The probability of a second event occurring given that a first event has already occurred.
Joint Probability of Two Independent Events	The probability of the first event multiplied by the probability of the second event.
Probability of One or Both of Two Independent Events	The sum of their individual probabilities minus their joint probability.

Example: Assume the following information:

- The probability of sales being \$1,000,000 in Year 1 is .30.
- **If** sales are \$1,000,000 in Year 1, the probability of sales being \$1,500,000 in Year 2 is .40.

The **joint probability** of sales being \$1,000,000 in Year 1 **and** of sales being \$1,500,000 in Year 2 is the probability that sales will be \$1,000,000 in Year 1 **multiplied by** the conditional probability that sales will be \$1,500,000 in Year 2, or:

$$.30 * .40 = \underline{.12} \text{ or } \underline{12\%}$$

The **conditional probability** is the likelihood that the second thing will occur, **given that** the first has already occurred. In this example, the **conditional probability** is .40 or 40%. This is a description of the occurrence of one event that is **dependent** upon another event's occurring.

Three Methods of Assigning Probable Values

There are three methods used to assign probable values to possible outcomes: the **Classical Method**, the **Relative Frequency Method** and the **Subjective Method**.

- **Classical Method** – This method assumes that each possible outcome has an equal probability of occurring. Thus, if there are ten possible outcomes, each outcome is assumed to have a 10% probability of occurring. This is the method used to assign probabilities to coin tosses or rolls of dice. In business decisions, we don't usually toss coins or roll dice, so the **classical method** is seldom used in situations of business uncertainty.
- **Relative Frequency Method** – When factual information is available that can be used to determine the probability of something occurring, the use of that information to assign probabilities is called the **relative frequency method**. The information may come from a sample, analytical data or any other reliable source. This method is also called the **Objective Method**.
- **Subjective Method** – This method is used when neither the classical nor the relative frequency methods can be used because the possible outcomes are not equally likely and relative frequency data are not available. With the **subjective method** of assigning probabilities, we use whatever data is available and add to that data our own experience and intuition. After considering all available information, we assign a probable value that expresses our **degree of belief** that the outcome will occur. Subjective probability is personal, and different people will assign different probabilities to the same event. In assigning subjective probability, it is still necessary to meet the two requirements: 1) the probable value for each possible outcome must be between 0 and 1; and 2) all the probabilities for all the possible outcomes must total 1.

Sometimes, the various methods are used in combination, as when probabilities are determined by combining estimates from the classical or relative frequency methods with subjective probability estimates.

Discrete and Continuous Random Variables

A **random variable** is a variable that can have any value within a range of values that occurs randomly and can be described using probabilities. A random variable can be set up so that exactly one numerical value is generated for the random variable. For example, we might need to analyze the number of items sold in one day. If x = the number of items sold in one day, x is the **random variable**. We do not know the exact value of the random variable until we have observed sales for one day. On one day, observed sales might be 1,500 items; on the next day, 1,725 items; on the next day, only 1,350, and so on.

If the random variable can take on any one of a number of values that can be counted and that are usually whole numbers— such as number of items sold — it is called a **discrete random variable**. For example, the number of customers coming into a store between the hours of 12 noon and 1 p.m. is a discrete variable, because the number of people can be counted, and there cannot be a partial person coming into the store. It will be a whole number like 50, 51, 52, 53, etc. The number can be as little as 1 or as large as several thousand; but it is possible to count it.

In some cases, a random variable can take on any value whatsoever within an interval or a collection of intervals. If a random variable can take on any value whatsoever in the interval from 0 to 100, for instance, such as 5.63504 or 72.36092, it is a **continuous random variable**, because there is no way to say how many different values the variable could assume. Any measurement with a set of values that form points on a line with no interruption or intervening spaces between the points is a continuous random variable.

To determine whether a random variable is discrete or continuous, choose two points representing values that the variable could take and graph them as points on a graph. If the line segment connecting the two points **also** represents possible values for the random variable, then the random variable is continuous. If the line segment between the two points **does not** represent possible values for the random variable (such as 1/2 of a person), then the random variable is discrete.

Discrete Random Variable Probability Distributions

We can develop a **probability distribution** for a discrete random variable by observing historical data.

Example: If we have a computer store, we may need to know how many computers are sold each day in order to make sure our inventory levels are sufficient. We could group together the number of computers sold each day to show how many days in a year we had no sales at all, how many days we had 1 sale, and so on. The maximum number of computers we have sold in any 1 day is 10. Our store is open 6 days per week, or 312 days per year. So we set up a table like the following:

<u>Number of Sales</u>	<u>Number of Days</u>
0	17
1	23
2	29
3	35
4	41
5	47
6	41
7	29
8	23
9	17
10	<u>10</u>
Total	312

Therefore, we will set up the following probability distribution:

<u>Number of Sales</u>		<u>Probability</u>
0	17/312	.06
1	23/312	.08
2	29/312	.09
3	35/312	.11
4	41/312	.13
5	47/312	.15
6	41/312	.13
7	29/312	.09
8	23/312	.07
9	17/312	.05
10	10/312	<u>.03</u>
Total		1.00

This means that the **probability** of our store selling no computers in a day's time is 6%. The probability that it will sell 10 computers in any one day is 3%. Notice that all of the probabilities add up to 100%.

If we graph these values, it will look like this:



This provides the probability distribution. We can see that the highest probability is associated with 5 sales per day. On any given day, for example, there is a 6% probability that no computers will be sold. There is also a 15% probability that 5 computers will be sold and a 3% probability that 10 computers will be sold.

After constructing this probability distribution, what do we do with it? We usually will want to compute the **expected value** of the random variable. **Expected value** is the same as the **mean** or **average** of the random variable, and when we are working with probabilities, it is a **weighted average**.

Expected Value

The **expected value** of a discrete random variable is the **weighted average of all the possible values** of the random variable. The weights are the probabilities for each of the values. The expected value is the **mean** value, also known as the **average** value. Over the long term, this is the **average number of computers that will be sold per day**. The symbol for the mean, average or expected value is μ , which is the Greek letter pronounced "mu."

Example: Continuing with the computer example, to determine the number of computers that we expect to sell on an "average" day, we multiply the possible number of computers that could be sold in a day by the probability of that happening. Then adding all of these different numbers together, we get the expected number of computers to be sold on an average day.

# of Sales		Probability		
0	x	.06	=	.00
1	x	.08	=	.08
2	x	.09	=	.18
3	x	.11	=	.33
4	x	.13	=	.52
5	x	.15	=	.75
6	x	.13	=	.78
7	x	.09	=	.63
8	x	.07	=	.56
9	x	.05	=	.45
10	x	.03	=	.30

Expected Value/Weighted Average 4.58

This means that each morning, the store should expect to sell 4.58 computers. Obviously, the store will never sell exactly this number since it cannot sell part of a computer.

Variance and Standard Deviation

The expected value gives us an average. The **variance** and **standard deviation** both give us an idea of the **variability** of the possible values for, in this case, the number of computers sold in a day's time. If on some days we sell no computers, and on other days we sell 10 computers, then there is a fairly large range for the number of computers on any given day.

The **variance** is used to **summarize the variability** in the values of a random variable (such as computers sold). Another word for this variability is **dispersion**. The amount of variability in the values of the random variable around their mean, or average, is the amount by which they are **dispersed**, or the amount of their **dispersion**. **Dispersion is a measurement of risk**. The greater the dispersion of the values around their mean, the greater is the risk associated with the values. If the values are highly dispersed about their mean, that means they vary widely from their expected value. If the values vary widely from their expected value, there is more chance that actual results will vary widely from forecasted results, and that creates risk. We will discuss this topic more fully a little further on in "Risk, Uncertainty and Expected Value."

The **variance** is represented by the symbol σ^2 , and it is the sum of the squares of all the differences – or deviations – from the mean (average), weighted according to their probabilities. This difference from the mean of each result is important because it tells us how far any particular measurement is on average from its **expected value**. The variance is actually a weighted average of the squared deviations.

The **standard deviation** is the positive square root of the variance. The variance is measured in squared units, whereas the standard deviation is measured in the same units as the variable, which in this example is the number of computers sold. Both measures tell us something about how much the various values are dispersed around the mean, which here is 4.58.

Example: Continuing to use our table of computers sold per day, we will calculate the **variance**:

Number of Sales x	$x - \mu$	$(x - \mu)^2$	Probability	$(x - \mu)^2$ × Probability
0	$0 - 4.58 = -4.58$	20.9764	.06	1.2586
1	$1 - 4.58 = -3.58$	12.8164	.08	1.0253
2	$2 - 4.58 = -2.58$	6.6564	.09	.5991
3	$3 - 4.58 = -1.58$	2.4964	.11	.2746
4	$4 - 4.58 = -.58$	.3364	.13	.0437
5	$5 - 4.58 = .42$	.1764	.15	.0265
6	$6 - 4.58 = 1.42$	2.0164	.13	.2621
7	$7 - 4.58 = 2.42$	5.8564	.09	.5271
8	$8 - 4.58 = 3.42$	11.6964	.07	.8187
9	$9 - 4.58 = 4.42$	19.5364	.05	.9768
10	$10 - 4.58 = 5.42$	29.3764	.03	.8813
Total = Variance $\sigma^2 = 6.6938$				6.6938

Standard deviation $\sigma = 2.59$

In a **normal distribution**, 68% of the values are expected to lie within one standard deviation from the mean, or expected result. In the above example, when the standard deviation is 2.59, it means that the probability is 68% that the actual sales made on any given day will be within ± 2.59 of the mean, or between 1.99 and 7.17 computers.

Question 38: Following is a table of probabilities for two separate product lines, X and Y:

<u>Probability</u>	<u>X profit</u>	<u>Y profit</u>
.20	\$500	\$50
.70	300	400
.10	600	800

The product line to obtain maximum utility for a risk-averse decision-maker is:

- a) X because it has the highest expected profit.
- b) Y because it has the highest expected profit.
- c) Y because it has the highest dispersion.
- d) X because it has the lowest dispersion.

(Source Unknown)

Continuous Random Variable Probability Distributions

A **continuous random variable** is a variable that can take on any value at all. It does not need to be an integer such as 1, 2, 3 or 4, though it can be an integer. A continuous variable can be 8.456, 10.623, 12.317, or any other number.

When we analyze the probability distribution of a continuous random variable, we cannot list each value and its probability like with discrete probability distributions. We need a different method for computing probabilities. For continuous random variables, we consider probability in terms of the probability that a variable will have a value **within a specified interval**. The probability of the variable having a value within a given interval is defined as the area under a graph called a **probability density function**.

The most important type of continuous distribution is the **normal probability distribution**.

Normal Probability Distribution

The **normal distribution** is the most important distribution, and it is often found in both nature and in human-made things. The graph of a **normal probability distribution** has the form of a bell-shaped curve that is centered on its mean. The mean and the standard deviation of the distribution explain it.

The bell-shaped curve is not always exactly the same height and width. The shape of the curve depends on the mean and the standard deviation of the random variable. A larger mean causes the top of the curve to be higher than a smaller mean. And a larger standard deviation causes the curve to be flatter and broader than a smaller standard deviation, because with a larger standard deviation, the dispersion of the data is greater. Probabilities for any normal probability distribution are computed by finding the area under the curve for the interval in question. The area under the curve for any interval is **equal to the probability that the random variable will take on a value in that interval**. The total area under any normal curve equals 1.

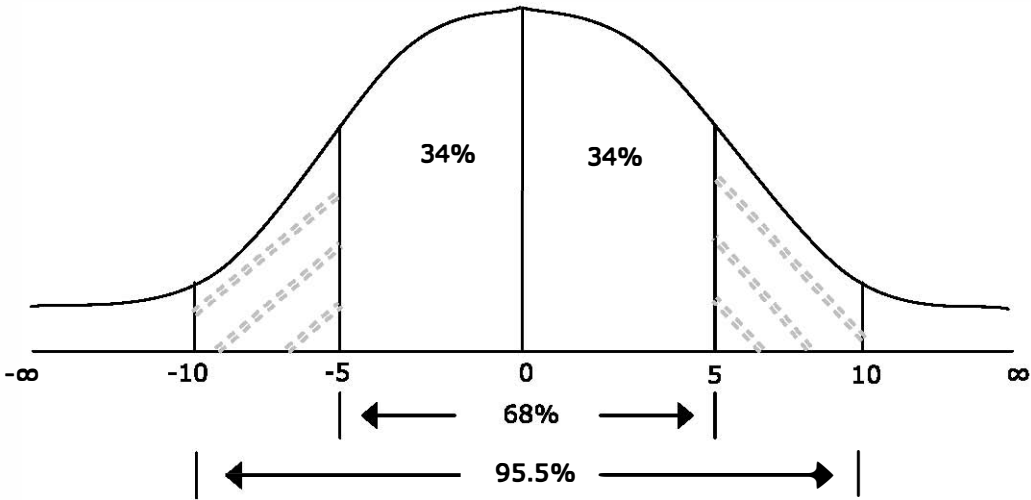
Note: Using this bell curve, tables have been created that tell us what % chance there is that the result will lie within a certain number of standard deviations from the mean. So, when we know the mean and the standard deviation, using tables we can determine what the probability is that the actual result will be within a certain range. You do not need to know how to do this, just know that these tables can be used.

In a normal distribution, **68%** of the values lie within **one standard deviation** of the mean.

In a normal distribution, **95%** of the values lie within **two standard deviations** of the mean.

In a normal distribution, **99.7%** of the values lie within **three standard deviations** of the mean.

Below is an illustration of the normal distribution with a mean of 0 and standard deviation of 5. The 68% and 95.5% lines represent the likelihood of a result being within 1 and 2 standard deviations from the mean.



Risk, Uncertainty and Expected Value

There are many definitions of risk. One definition is “a condition in which there is a possibility of an adverse deviation from a desired outcome.” This is risk defined in its negative connotation. However, in a very real sense, risk does not carry a negative connotation. Where investments are concerned (both capital investments and security investments), risk is the possibility that an investment’s **actual** return will differ from its **expected** return. This difference may be either positive or negative.

Risk for a **security** can be measured by the **variability** of its historical returns or the **dispersion** of its historical returns around their average, or mean, return. Thus, risk is measured by **variance** and **standard deviation**.

Uncertainty is risk that cannot be measured. In discussing a capital investment, we may or may not have information about historical returns on similar investments. If there is no information about historical returns for a particular investment, we are in the position of **decision-making under a condition of uncertainty**. When we are in this position, the probability distribution of possible returns must be determined **subjectively**.

For decisions involving risk and uncertainty, we use **expected value** or **expected return** to express the most likely result of our decision. And we use the **standard deviation** of the probability distribution of the potential returns as a measurement of the risk associated with the decision.

As we have already seen, the **expected value** of an action is found by multiplying the probability of each potential outcome by its payoff. Therefore, expected value, or expected return, is a weighted average of the possible returns, with the weights being the probabilities of occurrence.

If we are considering several possible capital budgeting projects, for instance, we would determine **expected cash flow** for each project in this manner. The probabilities of each potential cash flow would be determined **subjectively**. The resulting **expected cash flow** for each project is then used in the capital budgeting analysis. An example of this calculation is included in the following pages.

The **standard deviation** of the probability distribution of these subjectively determined potential cash flows expresses the **dispersion**, or **variability** of possible returns around our **expected return**. If the standard deviation is large, it means the variability of returns is large, and the risk of the project is higher. Thus, standard deviation is a measure of risk. By expressing differences from the expected return in terms of standard deviation, we can state the probability that the actual return will be greater or less than the expected return. The greater the standard deviation is, the greater is the potential for great loss — or great gain.

The **coefficient of variation** is a measure of risk per unit of expected return. It compares the amount of the variation in expected returns with the amount of the expected return. Using the expected, or rate of, return in the denominator, the coefficient of variation is calculated as follows:

$$\text{Coefficient of Variation} = \frac{\sigma}{\text{Expected Return}}$$

The higher this number is, the riskier the investment is.

Example: We are comparing two investment projects. Both have Internal Rates of Return of 20%, but Project A’s expected cash flow has a standard deviation of .15 and Project B’s expected cash flow has a standard deviation of .09. Which one is riskier?

$$\text{CV Project A} = .15 \div .20 = .75$$

$$\text{CV Project B} = .09 \div .20 = .45$$

Because it has a higher coefficient of variation, Project A is the riskier project.

The Mean, Median and Mode

Measures of central tendency are values typical of a set of data.

- 1) We have already discussed the **mean**, which is the average of a set of numbers. The **mean of a population** is represented by the Greek letter μ , or μ . The **mean of a sample** is represented with a bar over the letter representing the variable.
- 2) The **median** is the halfway value if raw data is arranged in numerical order from lowest to highest. Thus, half the values are smaller than the median and half of the values are larger than the median.
- 3) The **mode** is the most frequently occurring value. If all values are unique (different from each other), no mode exists.

Expected Value in Estimating Future Cash Flows

Estimating, or projecting, future cash flows is an important application of expected value. It is used in capital budgeting analysis for evaluating potential projects. The details of capital budgeting will be covered in the Investment Decisions section of the CMA Part 2 book. For now, though, you just need to know how to calculate estimated future cash flows from a potential project for use in a capital budgeting analysis.

When we see a budgeted amount of future cash flow, we tend to think of it as an absolute number. But unfortunately, this is something that in reality we cannot be certain of because there are many events that can affect a project's net cash flows. Every project has numerous **possible** future cash flows. A project has a **range** of estimated cash flows that reflect different possibilities as foreseen by management. To determine the various possible cash flows, management must:

- 1) Determine what influences have affected the net cash flows of similar projects in the past, such as economic conditions, labor conditions, or international conditions, and then
- 2) Make assumptions about each of those events. For instance, if a recession is expected, management would assume that demand for the project's product will be below normal.

Once these specific assumptions have been formulated, the financial manager then estimates the impact that each assumption could have on the net cash flow in each year of the project's life. The manager will develop several possible cash flow levels for each year, along with probabilities of each cash flow level occurring. The probabilities for each year will all sum to 1. The financial manager will then calculate the **expected value** for cash flow for each year of the project's life by calculating the weighted average of all the possible cash flows for each year. These expected values of future cash flows will be the cash flows used in the capital budgeting analysis for each year. This is described in detail in the following pages.

Statistical Measurements of Cash Flow Variability

When forecasting cash flows for investment projects, we might make several sets of forecasts for each project to reflect the various alternative states of the economy that might ensue. If we are comparing two project proposals, we might make several forecasts for the cash flows expected in Year 1, as follows:

	<u>Project A</u>	<u>Project B</u>
Economy in a deep recession	\$200,000	\$100,000
Economy in a mild recession	250,000	200,000
Economy stable	300,000	300,000
Economy in a minor expansion	350,000	400,000
Economy in a major expansion	400,000	500,000

Suppose our economists tell us that the probability of a deep recession occurring next year is 5%; a mild recession, 10%; a stable economy, 50%; a minor expansion, 25%, and a major expansion, 10%. Now we can calculate the expected value of the cash flows for both projects for Year 1:

	Probability (P)	Project A		Project B	
		Cash Flow	CF×P	Cash Flow	CF×P
Economy in a deep recession	5%	\$200,000	\$ 10,000	\$100,000	\$ 5,000
Economy in a mild recession	10%	250,000	25,000	200,000	20,000
Economy stable	50%	300,000	150,000	300,000	150,000
Economy in a minor expansion	25%	350,000	87,500	400,000	100,000
Economy in a major expansion	10%	400,000	<u>40,000</u>	500,000	<u>50,000</u>
Expected Value			\$312,500		\$325,000

Now we have **expected values** for cash flows for Projects A and B in Year 1, and we will do this for each year of each project's life. The **expected value** of the cash flows for each of the two projects is simply a **weighted average** of the possible cash flows, with the weights being the probabilities of each occurrence. This tells us that the expected value of Project B's cash flows is higher than the expected value of Project A's cash flows.

The expected value is not the whole story, however. Variation within the possible cash flows for each project is also important because a project with a high variability of cash flows has more risk than a project for which all the possible cash flows are close together. Look at the cash flows for both projects. Project A's possible cash flows range from a low of \$200,000 to a high of \$400,000, and the mean, or weighted average, is \$312,500. Project B's possible cash flows range from a low of \$100,000 to a high of \$500,000, and the weighted average is \$325,000. Which project's cash flow carries more risk? Project B's cash flow is riskier, because the range of possible cash flows is greater: the low is lower and the high is higher, and both the lowest and the highest cash flows are further from the expected value than are Project A's.

The riskiness of each project can be inferred from the **dispersion**, or variability, of the distribution of the possible results. The usual method of expressing dispersion of results is the **standard deviation**.

The variance and standard deviation of each of the expected cash flows is calculated in the same way as we calculated the variance and standard deviation of the number of computers sold each day. The narrower the distribution of the results, the lower the standard deviation will be – and the lower the risk will be. The wider the distribution of results, the greater the standard deviation will be and the greater the risk. So **standard deviation** is a measure of the **dispersion of a probability distribution** and thus a measure of the **riskiness of a project**.

The **variability**, or **dispersion** of forecasted results about their mean, is used to quantify risk.

The **standard deviation** of data is used to describe the **dispersion** of data about their mean. The mean is the weighted average of the data and also the expected value. The narrower the distribution of the data, the smaller the standard deviation will be and the lower the risk. The wider the distribution of the data is, the greater the standard deviation will be and the greater the risk will be.

Example: The standard deviation of Project A's Year 1 cash flow is:

Possible Cash Flows	Probability (P)	CF×P	$(CF - \text{Expected CF})^2 \times P$
\$200,000	.05	10,000	$(200,000 - 312,500)^2 \times .05 = 632,812,500$
250,000	.10	25,000	$(250,000 - 312,500)^2 \times .10 = 390,625,000$
300,000	.50	150,000	$(300,000 - 312,500)^2 \times .50 = 78,125,000$
350,000	.25	87,500	$(350,000 - 312,500)^2 \times .25 = 351,562,500$
400,000	.10	<u>40,000</u>	$(400,000 - 312,500)^2 \times .10 = \underline{765,625,000}$
Total		312,500	2,218,750,000 (variance)

The Standard Deviation σ = the square root of 2,218,750,000, or 47,104

This means that the probability is 68% (under a normal distribution of a bell curve), that the **actual** cash flow will be within $\pm \$47,104$ of \$312,500, or between \$265,396 and \$359,604.

The Standard Deviation of Project B's Year 1 cash flow is:

Possible Cash Flows	Probability (P)	CF×P	$(CF - \text{Expected CF})^2 \times P$
\$100,000	.05	5,000	$(100,000 - 325,000)^2 \times .05 = 2,531,250,000$
200,000	.10	20,000	$(200,000 - 325,000)^2 \times .10 = 1,562,500,000$
300,000	.50	150,000	$(300,000 - 325,000)^2 \times .50 = 312,500,000$
400,000	.25	100,000	$(400,000 - 325,000)^2 \times .25 = 1,406,250,000$
500,000	.10	<u>50,000</u>	$(500,000 - 325,000)^2 \times .10 = \underline{3,062,500,000}$
Total		325,000	8,875,000,000 (variance)

The Standard Deviation σ = the square root of 8,875,000,000, or 94,207

This means that the probability is 68% that the **actual** cash flow will be within $\pm \$94,207$ of \$325,000, or between \$230,793 and \$419,207.

Project B has a much higher standard deviation than Project A. This means that Project B has a **greater dispersion of possible outcomes**. Therefore, we can say what we could see intuitively from just looking at the cash flows: **Project B has greater risk.**

The **square of the standard deviation**, σ^2 , is called the **variance of the distribution**. In the above examples, Project A has a **variance** of $47,104^2$, or 2,218,786,816. Project B has a **variance** of $94,207^2$, or 8,874,958,849. The **variance of a population** is the average of the squares of the deviations of the measurements about their mean. When the concept of standard deviation is combined with probability as it is above, we are calculating a **weighted average** not only of the possible cash flows as we did first, but also of the squares of the variances. Thus, the **variance**, which in this case is a **weighted average**, is actually the weighted average of the squared deviations, which for Project A was 2,218,750,000, and for Project B was 8,875,000,000. (The small differences between the amounts above, calculated as the squares of the two standard deviations, and the amounts calculated in the example, are due to rounding.) The **variance of the distribution** is another indication of the riskiness of each project. The **variance** of Project B is greater than the **variance** of Project A.

The **coefficient of variation** is the ratio of the standard deviation of a distribution to the expected value of the distribution. The **coefficients of variation** for Project A and Project B are:

$$CV_A = \$47,104 \div \$312,500 = .15$$

$$CV_B = \$94,207 \div \$325,000 = .29$$

The coefficient of variation is greater for Project B than for Project A, which also means that Project B has a **greater degree of relative risk**.

So what do we do with this information now? We are considering two projects, Project A and Project B. Let's say for the sake of this discussion that they both entail the same initial investment and they are of the same length. Also, let's say they are mutually exclusive projects. If we choose A, we cannot choose B. If we choose B, we cannot choose A. The Expected Value of the cash flows from Project B for Year 1 – \$325,000 – is greater than the Expected Value of the cash flows from Project A for Year 1 – \$312,500. – Should we choose Project B because its expected cash flow is higher? Does the higher expected cash flow for Project B offset the increased risk we would be taking if we embark upon that project?

The answer to those questions is, of course, a judgment call that depends upon more information than we have here. But standard deviation as a measure of the variability of results can be used to quantify risk and thus assist in the decision-making process.

Summary of Probability and Expected Value

Probability is a numerical measurement of uncertainty. When a probability is based on counting and observed frequencies, it is **objective**. When a probability is an expression of whether an event in business will or will not occur, it may be based on the relative frequency of similar events having occurred in the past, or it may be based on someone's judgment. Either way, the probability has strong **subjective** elements.

Therefore, the concept of probability as it is used in business is a numerical measure of the **belief of an individual** in the occurrence or non-occurrence of an event. The probability assigned to an event depends upon the information and knowledge that the decision-maker uses in assessing the probability. As such, it is clearly subjective, individual, and dependent upon information. In fact, it has been said that probability does not exist in any absolute or objective sense.

Thus, we must remember that these are only **methods to obtain a recommended decision alternative or an optimal strategy** for the purpose of planning and budgeting. The actual results from the implementation of the decision will probably be quite different from the calculated expected value. The decision-maker's judgment is the deciding factor.

Question 39: A company uses two major material inputs in its production. To prepare its manufacturing operations budget, the company has to project the cost changes of these material inputs. The cost changes are independent of one another. The purchasing department provides the following probabilities associated with projected cost changes:

<u>Cost Change</u>	<u>Material 1</u>	<u>Material 2</u>
3% increase	.3	.5
5% increase	.5	.4
10% increase	.2	.1

The probability of a 3 percent increase in the cost of both Material 1 and Material 2 is:

- a) 15 percent
- b) 40 percent
- c) 80 percent
- d) 20 percent

(CIA Adapted)

Question 40: Ron Bagley is contemplating whether to investigate a labor efficiency variance in the Assembly Department. It will cost \$6,000 to undertake the investigation and another \$18,000 to correct operations if the department is found to be operating improperly. If the department is operating improperly and Bagley failed to make the investigation, operating costs from the various inefficiencies are expected to amount to \$33,000. Bagley would be indifferent between investigating and not investigating the variance if the probability of improper operation is:

- a) 0.29
- b) 0.40
- c) 0.60
- d) 0.71

(CMA Adapted)

Question 41: Ryerson Company has three sales departments, each contributing the following percentages of total sales: clothing, 50 percent; hardware, 30 percent; and household sundries, 20 percent. Each department has had the following average annual damaged goods rates: clothing, 2 percent; hardware, 5 percent; and household sundries, 2.5 percent. A random corporate audit has found a weekly damaged goods rate of sufficient magnitude to alarm Ryerson's management. The probability (rounded) that this rate occurred in the clothing department is:

- a) 50 percent
- b) 1 percent
- c) 25 percent
- d) 33 1/3 percent

(CMA Adapted)

Question 42: Two firms share customers in the same market. Firm A sampled its customers' buying habits and found that about 70 percent were repeat customers each week, while 30 percent went to Firm B. Firm B found that 80 percent of its customers remained loyal each week, while 20 percent switched to Firm A. If this retention and loss of customers continues for a long period, the percentage of customers Firm A will have is:

- a) 70 percent
- b) 80 percent
- c) 60 percent
- d) 40 percent

(CMA Adapted)

Question 43: A beverage stand can sell either soft drinks or coffee. If the stand sells soft drinks and the weather is hot, it will make \$2,500; if the weather is cold, the profit will be \$1,000. If the stand sells coffee and the weather is hot, it will make \$1,900; if the weather is cold, the profit will be \$2,000. The probability of cold weather on a given day at this time is 60%.

The expected payoff for selling coffee is:

- a) \$1,360
- b) \$2,200
- c) \$3,900
- d) \$1,960

(CMA Adapted)

Sensitivity Analysis

Sensitivity analysis encompasses a variety of methods used to determine how an expected result will change if factors that were involved in predicting an amount change. It is particularly helpful when there is a great deal of uncertainty about the various inputs to a decision model. In the context of expected values, sensitivity analysis involves selecting different values for the various probabilities and payoffs in a model, and changing them one at a time to determine whether the recommended decision alternative changes as a result, and by how much.

If a small change in the value of one of the inputs, such as a probability, would cause a change in the recommended decision alternative, then we say that the solution to the decision analysis problem is **sensitive to that input**. When we know that a particular input makes a big difference in the analysis, we can take extra care to make sure the value assigned to that input in the analysis is as accurate as possible.

Alternatively, if we find that changing a particular input makes no difference in the recommended decision alternative, then the solution is **not sensitive to that input**. If the solution is not sensitive to a particular input, we do not need to spend extra time or effort to make certain that the value assigned to that input is accurate.

This measure of the sensitivity of a project to a change in **one** of the variables also is an indication of the risk of the project. The more sensitive the project is to a change in the variables, the riskier it becomes.

Other uses for sensitivity analysis are:

- “What-if” analysis to determine the effect on a project if one variable changes.
- Determining the margin of safety, or the amount by which sales can decline without causing a loss.
- Determining operating leverage. **Operating leverage** refers to the effect of fixed costs on operating income at various levels of sales. If there is risk that sales levels will fall below projections, a prudent response to that risk is to reduce investments with high fixed costs.
- Cash flow budgeting, using different assumptions about selling prices and direct material costs.
- Developing expected values for cash flows to be used in capital budgeting.

Spreadsheet applications such as Excel make it possible to conduct sensitivity analysis in a systematic manner. However, a drawback to this approach is that numerous separate calculations may be required to evaluate, one at a time, the effects of several potential changes to the probabilities or other inputs.

Top-Level Planning and Analysis

Pro Forma Financial Statements

In business, the term *pro forma* is used to describe some kind of data, usually financial statements, where the data is on an “as if” basis, i.e., as if something in particular had happened. Pro forma financial statements are prepared for internal use in the process of planning. They are financial statements containing projected amounts that are expected if a particular course of action is followed. Pro forma financial statements are used in order to see what the financial statements of the firm will look like if something that is under consideration or forecasted actually happens. Pro forma financial statements are often used to evaluate what the effect will be on the company’s finances if a particular sales forecast is realized, although they can be used for other “what if” scenarios as well.

By analyzing the pro forma statements, managers can tell what the company’s cash position will be, whether it will need to borrow, whether it will be able to make its scheduled loan payments, whether it will remain in compliance with debt covenants, and so forth.

Pro forma financial statements are not the same thing as the master budget, although one or several versions of pro forma financial statements may be prepared as a part of the formal planning process that will eventually result in the master budget. Or, pro forma statements may be prepared after the formal budget for the year has been adopted if the company is considering an activity that was not foreseen before the formal budget was adopted. Pro forma financial statements are not prepared individually for each department and then consolidated into budgeted statements for the whole company the way budgeted financial statements are. They may be prepared for the company as a whole or for only one department or division – whatever is needed for the planning that is in process at the time.

Pro forma financial statements include a pro forma income statement, a pro forma statement of financial position (balance sheet) and a pro forma cash flow statement. In other words, they are a complete set of financial statements using **projected** amounts that tie together just like the amounts in the actual financial statements do.

Pro forma financial statements are used internally for five general purposes:

- 1) A pro forma financial statement is used to compare the company’s anticipated performance with its target performance and with investor expectations.
- 2) Pro forma statements are used for “what if” analysis, to forecast the effect of a proposed change. For example, if the company is contemplating a price increase which it anticipates will reduce the level of demand for its product, it will prepare a pro forma financial statement to determine the result on the financial statements if the price increase is put into effect.
- 3) They are used to determine in advance what the company’s future financing needs will be.
- 4) Various cash flow projections and sets of pro forma statements may be prepared using different assumptions for different operating plans. They are used to forecast the capital requirements of the plans in order to select the plan that maximizes shareholder value.
- 5) Pro forma financial statements are used to determine whether the company will be able to remain in compliance with the required covenants on its long-term debt. Long-term debt usually involves requirements for the company to maintain certain ratios in its financial statements, and these requirements are called **covenants**. Covenants are part of most loan agreements. One example of a covenant is a requirement that the company maintain a certain current ratio, such as at least 2:1. If the company’s current ratio falls below the required level, the company is technically in default on its debt, even though it may be making every scheduled payment. If that happens, the lender can legally demand payment of the entire loan balance immediately, which could force the company into bankruptcy. Therefore, it is very important that the company maintain compliance with its debt covenants.

Pro forma financial statements may also be prepared on a company by someone outside the company. For example, an investor or security analyst who is analyzing the company in order to forecast its future earnings, cash flows and stock price may also prepare pro forma financial statements on the company as part of the analysis. However, here we are discussing top-level planning that takes place **within** organizations, so we are not using the term *pro forma* in this sense.

Forecasting for Planning

We discussed forecasting in the section on Forecasting Techniques in this book. Now we will put some of those techniques into use.

Various approaches to forecasting are used, depending upon the situation. The three primary approaches used are:

- **Experience** – Because sales, expenses or earnings have grown at a particular rate in the past, we assume they will continue growing at that rate in the future. This leads to trend projections.
- **Probability** – We assume something will happen in the future because the laws of probability indicate it will. For example, probability is used to forecast the expected value of future cash flows from a proposed capital budgeting project.
- **Correlation** – Because there has been a high correlation in the past between one factor and another factor, such as increased advertising leading to increased sales, we use what we know about the first factor to forecast the second factor.

However, we need to remember when doing any forecasting that past performance is no guarantee of future performance. For this reason, all forecasts are subject to being wrong, and sometimes they are very far off. No one can forecast exactly what will happen in the future. We can only do our best, using the wisdom and insight that we have at the time.

Even if forecasts are not 100% accurate, forecasting is necessary. Forecasts of expected future situations are used to make decisions today. New products are planned, marketing and promotion plans are made, production quotas are set, and required financing is arranged based upon forecasts.

Sales Forecasting

In the Forecasting section of this book, we showed how to use historical sales information to develop a trend line to use in forecasting the next year's sales. Although history is useful, future sales are affected by events occurring in the future, not events that happened in the past. Therefore, future sales will depend upon the state of the domestic and global economy, the growth prospects for the market the company operates in, the company's future share of that market, the company's product line, new products that the company may be planning to introduce, and the company's marketing efforts. So the historical sales growth rate needs to be adjusted for any known factors that will affect future sales.

An accurate sales forecast is critical. For example, if the market the company operates in expands more than the company expects it to, the company will be unprepared to meet the added demand and it will lose customers to its competitors. But if the company's forecasted sales are too high, then the company could end up with excess capacity and excess inventory, which will hurt cash flow. If the company has borrowed to expand in the expectation of higher sales and those higher sales do not materialize, then the company will be stuck with high interest charges on its debt in addition to unsold inventory and unused capacity. Therefore, management needs to use its best judgment about the future **along with** historical information and not simply rely on a forecast made using regression analysis or any of the other forecasting techniques.

Forecasting Future Financing Needs

When a company's sales increase, the company will need additional funds. More inventory will be needed to support the increased sales. Accounts receivable will increase in proportion to the increase in sales. The company may need to purchase new equipment. There are three sources of funding for the expected increases in assets.

- 1) When inventory increases, accounts payable will increase as well, just because more inventory is being purchased and/or manufactured. Accrued liabilities (accrued salaries and wages, accrued taxes, etc.) will also increase because of the increased activity. This increase in liabilities, called a **spontaneous liability increase**, will fund a portion of the increase in assets. These are called spontaneous liability increases because they occur naturally.

Note: borrowed funds, i.e., bank loans or bonds issued, are **not** liabilities that increase spontaneously. The company needs to do something intentional to cause its borrowings to increase, for instance request a bank loan or issue bonds. Therefore, borrowed funds do not increase spontaneously.

- 2) Profits from the additional sales will provide some of the funding. Any profits not paid out in dividends increase retained earnings. The additional retained earnings increase equity and provide a source of funds.
- 3) The remainder of the funding above what can be supplied by 1) and 2) above will need to be provided through external financing, such as bank loans (short-term and/or long-term) or issuance of securities (stock or bonds).

The amount of external financing that will be required depends upon several factors:

- 1) **The company's rate of sales growth.** Rapid sales growth generates increases in assets, and increases in assets generate the need for external financing. The **higher** the growth rate in sales, the **greater** will be the need for additional financing.
- 2) **The company's capital intensity ratio, or the amount of assets required per dollar of sales.** The capital intensity ratio is assets that increase when sales increase divided by sales, and it affects capital requirements. The **higher** the company's capital intensity ratio, the more assets it will require for a given increase in sales and thus it will have a **greater** need for external financing than a company with a lower capital intensity ratio.
- 3) **The company's spontaneous liabilities-to-sales ratio.** Companies that can finance more of their working capital needs by using accounts payable and accrued liabilities will have less need for external financing, so a higher ratio means less external financing will be needed, while a company with a **lower** ratio will have a **greater** need for external financing.
- 4) **The company's net profit margin.** The higher a company's net profit margin is, the more increased net income will be available to fund increases in assets and the less need the company will have for external financing. The **lower** the net profit margin, the **greater** need the company will have for external financing.
- 5) **The company's retention ratio.** The retention ratio is the amount of net income not paid out in dividends and retained in the company. Companies that payout less of their net income in dividends will have more retained earnings and less need for external financing than companies that pay out more of their net income in dividends. Therefore, companies with **lower** retention ratios will have a **greater** need for external financing.

- 6) **Planned changes in policies and procedures.** These may have little or nothing to do with sales growth, or, like accounts receivable terms, they may affect sales growth. Examples are plans to extend more or less liberal financing terms to customers or plans to change to a different major supplier that offers more or less favorable terms to the company. Both of these changes may affect the company's need for external financing. More liberal financing terms extended to customers will increase sales and profits but will also create more uncollectible accounts and an increased level of accounts receivable. The net effect on the need for additional financing will depend on the balance between the increased profit from the increased sales which will decrease the need for external financing, and the increase in accounts receivable because of the higher sales and longer payment terms, which will increase the need for external financing. Likewise, a change in a major supplier that requires payment to be made sooner may be coupled with a lower price. That net effect on the need for additional financing will also depend on the balance between the lower cost of the product which would increase profits and decrease the need for external financing, and the need to make payment sooner which would decrease the level of accounts payable and increase the need for external financing.

Medium-term forecasting covers periods of up to one year in the future, while long-term forecasting covers multiple years. The Forecasted Financial Statement method is a method of forecasting the additional funds needed that is well suited to medium- and long-term use. It is not the only method, but it is the most flexible method and the one covered on the exam.

Short-term cash forecasting covers periods of 30 days or so in the future and is based on actual data (i.e., expected receipts from actual accounts receivable outstanding, expected payments of actual accounts payable, etc.) rather than on projected data. That is not the type of cash forecasting we will discuss here.

The Forecasted Financial Statement (FFS) Method

The **Forecasted Financial Statement** approach to forecasting future financing needs forecasts a complete set of pro forma financial statements, including income statement, balance sheet, and statement of cash flows. We begin with a forecast of sales and we forecast the assets (i.e., accounts receivable, inventory, fixed assets) that will be needed to support those sales, as well as the spontaneous liabilities (i.e., accounts payable, accruals) and the increase in retained earnings. All of the sources of financing are forecasted, including existing debt and equity. The increase in retained earnings is forecasted by forecasting the entire income statement and the dividend payments. The difference between total assets and total liabilities and equity when all this has been completed is the additional funds needed, which is a "plugged" figure on the balance sheet.

The FFS method produces a forecast of the entire balance sheet and income statement. The pro forma balance sheet and income statement can then be used to create the pro forma statement of cash flows. We will illustrate the development of all of these pro forma statements in the following pages.

Steps in Forecasting Using the Forecasted Financial Statement Method

- 1) **Analyze historical ratios** that will be used for the projections. The ratios to be used will relate the various items to sales by dividing each one by sales. Look at the actual ratios for at least the past 5 years, the historical average over the same period, and the industry average (developed from financial statements for all firms in the industry) for the following ratios:
 - Costs to sales (COGS to sales, SG&A to sales)
 - Depreciation to net property, plant and equipment
 - Cash to sales
 - Accounts receivable to sales
 - Inventory to sales

- Net property, plant and equipment to sales
- Accounts payable to sales
- Accruals to sales

Look for trends in the ratios and look at how the current ratios compare with their historical averages and determine the cause of differences. Any change from the historical trend that has happened recently might be caused by temporary factors, and in the future, the ratio might move back toward its average. Compare the ratios with the industry averages. Consider the effects of the economy on sales and look at what is happening in the industry the company operates in, to determine whether external factors might affect the ratios in the future. And consider any known operating plans of the company, such as a planned expansion. If the company has been preparing for an expansion, its projected costs might need to be increased temporarily due to things like increased anticipated advertising costs.

Example: Here are historical ratios for ABC Industries. Because of lack of space, we will use only 2 years of history, although in practice, 5 years should be used. Note that all of these ratios relate the item to be forecasted to sales by dividing the historical level of the item by historical sales. These ratios are used specifically for forecasting balance sheet and income statement items based on forecasted sales, and therefore they are different from ratios that are used for financial statement analysis.

	Actual <u>2008</u>	Actual <u>2009</u>	Historical <u>Average</u>	Industry <u>Average</u>
COGS to sales	74.3%	75.5%	74.9%	72.5%
SG&A costs (excluding depreciation) to sales	17.3%	17.9%	17.6%	17.0%
Depreciation to net property, plant & equip	9.7%	9.1%	9.4%	9.4%
Cash to sales	0.6%	0.4%	0.5%	0.9%
Accounts receivable to sales	10.9%	11.2%	11.1%	10.8%
Inventory to sales	10.5%	12.5%	11.5%	12.0%
Net property, plant & equipment to sales	31.6%	32.3%	32.0%	33.5%
Accounts payable to sales	1.5%	2.4%	2.0%	1.5%
Accruals to sales	5.3%	5.9%	5.6%	4.5%

2) **Forecast the income statement.** The income statement and the balance sheet really need to be integrated, although the balance sheet is forecasted in the next step.

- **Forecast sales.** If management expects a 10% increase in sales for the current year, as in the example of ABC Industries above, forecasted sales will be the previous year's sales multiplied by 1.10. Using our ABC Industries example, sales are forecasted to be \$150,000 × 1.10, or \$165,000.
- **Forecast Earnings Before Interest and Taxes (EBIT).** Take the actual income statement for the most recent year and adjust it using the historical ratios, where appropriate, to develop the forecast for the current year. This will be demonstrated in the example that follows.
- **Forecast interest expense.** Net interest expense is the sum of the company's daily interest charges on all of its loans (short-term and long-term) minus its daily interest income from short-term investments. The amount of interest expense depends on the outstanding loan balances and the interest rate on those loan balances.

However, these loan balances will not be the same all year long. So what outstanding loan balance should be used in calculating the interest expense on debt? There is more than one approach.

- One way is to use the loan balances expected at the end of the forecasted year. However, this would create a full year's interest charge on any added debt, meaning the new debt was

expected to be in place at the very beginning of the year, which is unlikely. So this would overstate interest expense.

Another problem with this approach is called **financing feedback**. The final amount of borrowings at the end of the year will not be known until the entire income statement (including interest expense) and balance sheet have been forecasted, because the difference between total assets and total liabilities and equity will be the additional financing needed. Increasing the amount of financing needed on the pro forma balance sheet will cause interest expense on the pro forma income statement to increase, which will reduce the addition to retained earnings and in turn, require an even higher level of debt which will create even higher interest expense, and so on, in a never-ending cycle. This can be dealt with in a spreadsheet, but it increases the complexity of the projections beyond what the benefits may justify.

- Another approach is to use the average of the debt at the beginning and the end of the year. If the debt is added evenly throughout the year, this would produce the correct interest expense. However, that is usually not the case. Furthermore, because the year-end debt level is used to calculate the average debt, the problem of financing feedback exists with this approach, as well.
- A third method, which is used in the example that follows, works well in most situations and avoids the problem of financing feedback. The interest expense is based on the level of debt at the **beginning** of the year to be forecasted. The problem with this approach, of course, is that if the debt level increases during the year, which it no doubt will, the interest expense will be underestimated. This can be dealt with by calculating interest expense using a forecasted interest rate that is approximately 0.5% higher than the interest rate actually expected.

Note: In an essay exam question, if you use the approach of basing forecasted interest expense on the loan balances at the beginning of the year and adding 0.5% to the expected interest rate in recognition of increasing levels of debt during the year, you should **make sure you note this assumption in your answer and give your reason for using it.**

Different loans have different interest rates. For our forecast, we will use just two rates: one for short-term borrowings and one for long-term borrowings. The rate to use for short-term borrowings should be the present rate, increased by 0.5%. For long-term debt, we use an average of the rates on the current outstanding long-term borrowings and the rate that is expected on any new long-term debt, increased by 0.5%. The forecasted interest expense will be the net forecasted interest expense on short-term financing plus the forecasted interest expense on long-term bonds. This will also be calculated in the example following.

- **Complete the income statement.** Interest expense is subtracted from EBIT to calculate EBT. We then subtract tax at a given tax rate to calculate net income before preferred dividends; and then we subtract preferred dividends to calculate net income available to common shareholders. Net income available to common shareholders divided by the number of shares of common stock will give us Earnings Per Share. (For forecasting purposes, we do not distinguish between Basic Earnings Per Share and Diluted Earnings Per Share.) Common dividends per share multiplied by the number of common shares equals the total dividends paid on common stock. The forecasted addition to retained earnings is net income available to common stockholders minus total common dividends. (Note that this is the same as net income minus preferred dividends minus common dividends.)

Example:

Here are ABC Industries 2009 actual and 2010 projected income statements (000 omitted) that are adjusted to recognize the obligation to pay preferred dividends in order to use them to calculate Earnings Per Share.

	<u>Actual 2009</u>	<u>Forecast Based On</u>	<u>Forecast 2010</u>
Sales	\$150,000	2009 sales $\times$ 1.10	\$165,000
COGS (including depr.)	<u>113,210</u> ¹	2010 sales $\times$.755 (incl. \$3,478 depr.)	<u>124,575</u> ¹
Gross profit	\$ 36,790		\$ 40,425
SG&A exp. excluding deprec	26,880	2010 sales $\times$.179	29,535
Depreciation expense-SG&A only	<u>409</u> ¹	See Note 1 below.	<u>446</u> ¹
EBIT	\$ 9,501		\$ 10,444
Less: Net interest	<u>1,579</u> ²	See Note 2 below.	<u>1,706</u>
Earnings before taxes (EBT)	\$ 7,922		\$ 8,738
Taxes at 40%	<u>3,169</u>		<u>3,495</u>
Net income before pref. divs.	\$ 4,753		\$ 5,243
Preferred dividends	<u>200</u> ³	See Note 3 below.	<u>200</u>
Net income avail. to common	<u>\$ 4,553</u>		<u>\$ 5,043</u>
No. shs. common stock outst.	1,920		1,920
Dividends per share	<u>\$ 1.25</u> ⁴	See Note 4 below.	<u>\$ 1.30</u>
Dividends to common	<u>\$ 2,400</u>	Div. per sh. $\times$ no. shs	<u>\$ 2,496</u>
Addition to retained earnings	<u>\$ 2,153</u>	NI avail. to comm. – divs. to comm.	<u>\$ 2,547</u>
Earnings per share	\$ 2.37	NI avail. to comm. $\div$ no. shs. outst.	\$ 2.63

¹Net property, plant and equipment equaled 32.3% of sales in 2009, and total depreciation equaled 9.1% of net plant and equipment in 2009, or \$4,409 in total. 2009 COGS includes \$3,160 in depreciation expense on manufacturing facilities: \$840 of the depreciation was capitalized in inventory; and SG&A depreciation is \$409. The forecast for net property, plant and equipment for 2010 is sales of \$165,000 $\times$.323, or \$53,295; and the forecast for total depreciation for 2010 is \$53,295 $\times$.091, or \$4,850. \$3,478 of the forecasted 2010 depreciation is expensed in COGS; \$926 is capitalized in inventory; and \$446 is in SG&A.

²Short-term loan balance at the end of 2009/beginning of 2010 is \$10,000 and the expected average interest rate on short-term borrowings is 5%. Long-term loan balance at the end of 2009/beginning of 2010 is \$15,410 and the expected average interest rate on long-term borrowings is 7%. Interest rates have been increased by 0.5% to reflect increased borrowing levels expected throughout the year. Therefore, the forecasted interest is 5.5% on short-term borrowings of \$10,000 plus 7.5% on long-term borrowings of \$15,410. $(\$10,000 \times .055) + (\$15,410 \times .075) = \$1,706$.

³Preferred dividends are due on 40,000 shares of \$100 par preferred stock at 5%.

⁴ABC paid a dividend on common stock in 2009 of \$1.25 per share. The company does not plan to issue any new shares in 2010 and plans to increase the dividend by 4% for 2010 to \$1.30 per share.

3) Forecast the Balance Sheet.

- **Forecast operating assets.** We will use the ratios for 2009 for current assets. The 2009 ratio of cash to sales was 0.4%; accounts receivable to sales was 11.2%; and inventory to sales was 12.5%. However, the amount of net property, plant and equipment may or may not be proportional to sales. A manufacturer's fixed assets will stay at a given level as long as sales remain within the relevant range, and then they will increase all at once. On the other hand, a retail store chain grows by opening new stores, and for that business, fixed assets will increase more in proportion to sales. In the long term, all costs are variable costs. So in the long run, there will be a strong relationship between sales and fixed assets for all companies. For short-term forecasting, companies usually use planned investment in plant and equipment. Since that kind of specific information may not be available for a medium or long-term forecast, it is reasonable to assume a constant ratio of net plant and equipment to sales. For ABC, we will use the 2009 ratio of net plant & equipment to sales.
- **Forecast operating current liabilities.** Increased sales will require increased purchases of raw materials, which will lead to higher accounts payable. The most recent ratio of accounts payable to sales is used to forecast the level of accounts payable. In addition, higher sales will require more direct labor to do the manufacturing, so accrued wages will increase. Higher sales will also result in higher taxable income for the company, so accrued taxes will also increase. These ratios for the most recent year will also be used to forecast the 2010 levels.
- **Forecast items determined by policy decisions.** The remaining liability and equity items depend on the company's financial policies. We will assume the following policies: No additional common or preferred stock will be issued, dividends will be increased at a rate of 4% per year, and no new bonds will be issued. Short-term notes payable will be used for new financing requirements, since the company has a line of credit that it can use. So we will assume that long-term debt and equity will be the same during the year as they were at the end of the previous year. Temporarily, we will use the same short-term notes balance as was outstanding last year; but this will be a "plug" figure after everything else is done, so it is subject to change.

Example: Here is ABC Industries' actual 2009 balance sheet and forecasted 2010 balance sheet (000 omitted). The Notes Payable line has been "plugged" to make the balance sheet balance.

	<u>Actual 2009</u>	<u>Forecast based on</u>	<u>Forecast 2010</u>
Assets			
Cash & Cash Equivalents	\$ 600	2010 sales × .004	\$ 660
Short-term investments	0	If extra funds, use as plug	0
Accounts receivable	16,800	2010 sales × .112	18,480
Inventories (incl \$840 of depr.)	<u>18,800</u>	2010 sales × .125 (incl. \$926 of depr.)	<u>20,625</u>
Total current assets	\$ 36,200		\$ 39,765
Net property, plant and equip	<u>48,450</u>	2010 sales × .323	<u>53,295</u>
Total assets	\$ 84,650		\$ 93,060
Liabilities and Equity			
Accounts payable	\$ 3,600	2010 sales × .024	\$ 3,960
Accrued liabilities	8,850	2010 sales × .059	9,735
Notes payable	<u>10,000</u>	2009 bal. of \$10,000, plug if needed	<u>14,618</u> ¹
Total current liabilities	\$ 22,450		\$ 28,313
Long-term debt	<u>15,410</u>	2009 bal. of \$15,410	<u>15,410</u>
Total liabilities	\$ 37,860		\$ 43,723
Preferred stock	\$ 4,000	2009 bal. of \$4,000	\$ 4,000
Common stock	\$ 1,920	1,920,000 shs, par value \$1, no change	\$ 1,920
Additional paid-in capital	13,000	No change	13,000
Retained earnings	<u>27,870</u>	2009 RE + \$2,547 addition to RE	<u>30,417</u>
Total common equity	\$ 42,790		\$ 45,337
Total liabilities and equity	\$ 84,650		\$ 93,060
Required assets ²			\$ 93,060
Specified sources of financing ³			<u>88,442</u>
Additional funds needed (AFN)			<u>\$ 4,618</u>
Required additional notes payable			\$ 4,618
Additional short-term investments			0

If the specified sources of financing had been **greater** than the required assets instead of less than the required assets, then ABC would not need any additional financing and would have excess financing.

¹ Note that notes payable has been "plugged" to increase it from \$10,000 by the amount of the additional funds needed to \$14,618.

² Required assets are all of the forecasted operating assets (\$104,115) plus short-term investment balance (0) for the previous year.

³ Specified sources of financing include the forecasted operating current liabilities (accounts payable and accruals only, \$13,695), forecasted long-term debt (\$15,410), forecasted preferred stock (\$4,000), forecasted common equity (\$45,337), and notes payable for the previous year (\$10,000).

Knowing how much additional funds will be needed is one of the most important uses of pro forma financial statements. If financial managers know how much funding they expect to need, they can make arrangements to obtain the financing before the need becomes critical. In the example above, the need is not great and the company can obtain the funds by borrowing them on a short-term basis. If the amount needed is large, though, the company may decide to issue new stock or a new bond.

- 4) **Construct a pro forma statement of cash flows.** Once the pro forma income statement and pro forma balance sheet are complete, a pro forma statement of cash flows can be constructed in the same manner as a statement of cash flows is constructed for actual results using the actual income statement and actual balance sheet. We have constructed both direct and indirect pro forma cash flow statements using the 2009 actual and 2010 pro forma balance sheets and the 2010 pro forma income statement for ABC Industries. **Make sure you understand where all of the amounts on the following two versions of the statement of cash flows come from.**

Here is the pro forma *direct* Statement of Cash Flows for ABC Industries:

Cash Flows from Operating Activities:

Cash received from sale of goods	<u>\$163,320</u>	
(Net sales \$165,000 plus Beginning A/R \$16,800 Minus Ending A/R \$18,480)		
Cash provided by operating activities		\$163,320
Cash paid to suppliers	<u>\$121,636</u>	
(COGS \$121,097 [\$124,575 minus \$3,478 depr] minus Beginning inventory including depreciation \$18,800 plus Ending inventory excluding depreciation \$19,699 plus Beginning A/P \$3,600 minus Ending A/P \$3,960)		
Cash paid for operating expenses	<u>28,650</u>	
(SG&A exp. excluding depreciation \$29,535 plus Beginning accrued liabilities \$8,850 minus Ending accrued liabilities \$9,735)		
Cash interest paid	<u>1,706</u>	
Cash taxes paid	<u>3,495</u>	
Cash disbursed for operating activities		<u>155,487</u>
Net cash flows from operating activities		\$ 7,833

Cash Flows from Investing Activities:

Purchase of equipment	<u>(9,695)</u>	
(Beginning PP&E \$48,450 minus 2010 depr. \$4,850 = \$43,600. Ending PP&E \$53,295 minus \$43,600 = Equipment purchased.)		
Net cash used in investing activities		(9,695)

Cash Flows from Financing Activities:

Dividends paid	<u>(2,696)</u>	
(Common dividends \$2,496 plus Preferred dividends \$200)		
Increase in notes payable	<u>4,618</u>	
Net cash flows provided by financing activities		<u>1,922</u>
Net increase in cash		\$ 60
Cash and cash equivalents at beginning of year		<u>600</u>
Cash and cash equivalents at end of year		\$ 660

Here is the pro forma *indirect* Statement of Cash Flows for ABC Industries:**Cash Flows from Operating Activities:**

Net income	\$ 5,243	
Add/(deduct) items not affecting cash:		
Increase in accounts receivable	(1,680)	
Increase in inventories	(899)	
(Ending inventory excluding depr \$19,699 minus		
Beginning inventory including depr \$18,800)		
Depreciation expense	3,924	
Increase in accounts payable	360	
Increase in accrued liabilities	<u>885</u>	
Net cash flows from operating activities		\$7,833

Cash Flows from Investing Activities:

Purchase of equipment	(<u>9,695</u>)	
(Beginning PP&E \$48,450 minus 2010 depr. \$4,850		
= \$43,600. Ending PP&E \$53,295 minus \$43,600 =		
Equipment purchased.)		
Net cash used in investing activities		(9,695)

Cash Flows from Financing Activities:

Dividends paid	(2,696)	
(Common dividends \$2,496 plus		
Preferred dividends \$200)		
Increase in notes payable	<u>4,618</u>	
Net cash flows provided by financing activities		<u>1,922</u>
Net increase in cash		\$ 60
Cash and cash equivalents at beginning of year		<u>600</u>
Cash and cash equivalents at end of year		\$ 660

Analysis of Pro Forma Financial Statements

Developing the forecast is only the beginning. The pro forma financial statements that result need to be analyzed to determine whether the firm's forecasted financial situation meets the firm's targets. If it does not, then changes will be needed, not just to the forecast but to the operating plans that resulted in the forecast, and the pro forma statements will need to be done again.

Part of the analysis is an analysis of financial ratios. Ratio analysis is used to compare the firm's actual ratios and projected ratios with target ratios as well as the latest industry average ratios.

Here are the ratios we will use to analyze ABC's pro forma financial statements. Although average balances for balance sheet items are preferable for financial statement analysis when relating an income item to a balance sheet item, if averages are not available, it is acceptable to use ending balances. For this purpose, we will be comparing ratios for year-end 2009 with ratios for forecasted year-end 2010 and 2009 year-end industry averages. Since averages are not available for the industry, we will use all year-end balances to be consistent.

Current ratio:	Total current assets / Total current liabilities
Inventory turnover:	Annual cost of sales / Inventory
Days sales in inventory	365 / Inventory turnover OR Average inventory / (Cost of goods sold / 365)
Accounts receivable turnover:	Annual credit sales / Accounts receivable
Days sales in receivables:	365 / Accounts receivable turnover OR Average Accounts receivable / (Annual credit sales / 365)
Interest coverage ratio	EBIT / Interest expense
Asset turnover:	Net sales / Total assets
Debt to equity ratio:	Total liabilities / Total equity
Gross profit margin:	Gross profit / Net sales
Net profit margin:	Net income¹ / Net sales
Return on assets:	Net income¹ / Total assets
Return on equity:	Net income¹ / Total equity

¹ Net income = Net income before preferred dividends

Here are the key ratios. It would be a good idea to recalculate these ratios so you understand them.

	Actual <u>2009</u>	Forecast <u>2010</u>	Industry Average <u>2009</u>
Current ratio	1.6 to 1	1.4 to 1	2.0 to 1
Inventory turnover	6.0 times	6.0 times	5.5 times
Days sales in inventory	60.8 days	60.8 days	66.4 days
Accounts receivable turnover	8.9 times	8.9 times	8.0 times
Days sales in receivables	41.0 days	41.0 days	45.6 days
Interest coverage ratio	6.0 to 1	6.1 to 1	7.2 to 1
Asset turnover	1.8 times	1.8 times	1.9 times
Debt-to-equity ratio	80.9%	88.6%	75.0%
Gross profit margin	24.5%	24.5%	30.7%
Net profit margin	3.2%	3.2%	4.5%
Return on assets	5.6%	5.6%	8.5%
Return on equity	10.2%	10.6%	12.0%

Of course, the ratios for forecasted 2010 are very similar to the ratios for actual 2009. That is because we used the 2009 ratios between the various items and sales as models for the 2010 forecast.

The first step is to analyze these ratios and especially to compare them with the industry averages. ABC's ratios are a little better than the industry averages for inventory and receivables turnover but worse than the industry averages for everything else.

After comparing the company's ratios to the industry averages, the next step will be to analyze the actual and pro forma financial statements to determine what is causing ratios that are worse than the industry averages to be worse than the industry averages. ABC's debt to equity ratio is higher than the industry average, which means its interest expense is higher than that of its peers. Furthermore, a considerable amount of the debt is short-term, and that is causing its current ratio to be lower than the industry average.

ABC's gross profit margin, net profit margin, return on assets and return on equity are all much lower than the industry averages. This means ABC is making fewer dollars of sales for each dollar invested in assets than other companies in the same industry; and also that the amount of profit it is earning on each dollar of those sales is lower.

As a result of this analysis, ABC is looking at its cost of sales to see if there is waste in the production process. It is also studying the profitability analyses by product line to determine whether some of the less profitable product lines should be discontinued or changed. If the company can improve its profitability, it should be able to pay down some of its debt and lower its interest expense, as well.

After the company makes its decisions about operational changes to be made, it will revise the pro forma statements for 2010 and recalculate the ratios to see whether the changes will create enough improvement in the ratios to enable the company to reach its targets. If so, it will pursue those changes. If not, the company will reconsider what else needs to be changed in its operations in order to achieve its objectives.

After the pro forma financial statements have been revised and the operational changes have been made, the company's management will need to evaluate its actual results against the pro forma statement to determine whether its objectives have been met. The primary method of making this determination will be a comparison of the actual ratios and the pro forma ratios.

We do not show the revised pro forma financial statements or the revised ratios here.

Other Uses of Pro Forma Financial Statements

Pro forma financial statements can be used to evaluate the company's dividend policy. ABC Industries has had a policy of increasing its dividend every year, and it has projected a 4% increase in its dividend for 2010. However, if the company were to reduce the growth rate in the dividend, additional funds would be available to invest in plant, equipment or inventories, used to reduce borrowings, or possibly used to repurchase its stock.

Another important use of pro forma statements is determining whether the company will be in compliance with its debt covenants. As we explained earlier, covenants in a loan agreement are used by the lender to require the borrower to maintain certain financial ratios. If the borrower fails to maintain those ratios, then the lender can declare the loan in default and can require payment of the outstanding balance immediately (called **accelerating** the loan). Acceleration of its loans usually forces a firm to declare bankruptcy and may cause it to go into liquidation, so it is a serious matter.

Some of the usual covenants include maintenance of a minimum current ratio, maintenance of a minimum debt ratio, and maintenance of a minimum interest coverage ratio. So calculation and analysis of these ratios need to be a part of the analysis of the pro forma statements. If the pro forma statements indicate that the covenants may not be met unless changes are made, the necessary operational changes must be made urgently to prevent that from occurring.

Section B – Performance Management

Performance Management represents 25% of the CMA Part 1 exam. Part 1 is a four hour exam that will contain 100 multiple-choice questions and 2 essay questions. Topics within an examination part and the subject areas within topics may be combined in individual questions. Therefore, we cannot predict how many multiple choice questions you may get from this section, nor can we predict whether you will get any essay questions from this section. The best approach to preparing for this exam is to know and understand the concepts well and be ready for anything.

Mathematically, the majority of the questions will come from variance analysis and performance measurement parts of this section. A number of variances are covered, and you need to know not only how to calculate them, but also what they mean and who can affect them. While the variance topic may seem large and overwhelming at first, when it is broken down into its individual elements it will become easier.

The performance measurement portions focus on a few performance measures, specifically Return on Investment (ROI) and Residual Income (RI). For these measurements you need to know what they are, how they are calculated and how they are used. You also need to be able to identify the weaknesses that are inherent in each one.

In addition to these topics, there are a few other larger topics in this section.

Responsibility accounting is the breaking down of costs into those costs that can be controlled by the manager and those that cannot be controlled by the manager. There are a number of different cost classifications and allocation methods within this section that you need to be aware of.

Transfer pricing is a topic that you need to know from both a theoretical standpoint and a numerical one as well. The questions may require you to understand the issues that company faces in establishing the transfer price as well as being able to calculate an acceptable transfer price under certain situations.

The final topic covered in this Section is performance feedback, and more specifically the balanced scorecard. You need to know conceptually what the balanced scorecard is and how it works as well as be familiar with its application.

Introduction to Variance Analysis and Standard Costs

Variance analysis is the process of comparing the actual expenses and revenues during a certain period to the budgeted amounts for that same period. Through the use of variance analysis, we are able to determine why our actual results were different from the budgeted amounts. This will enable us to focus our efforts on the areas of the operations that have been operating less efficiently than planned.

We introduced standard costs in the Budgeting section. Before getting into the process of variance analysis, we need to look them again and the role they play in the accounting and costing system.

A **standard cost** is an estimate of the cost the company expects to incur in the production process. Without a standard cost, the analysis of actual activities and results is very difficult because there is no standard against which to measure the performance.

This standard cost is calculated prior to the **beginning of each year** and it is **based on the estimated costs** and the **expected level of activity** or production. As we saw in the Budgeting section, standard costs are determined through the use of accounting and production estimates. They are not simply created by management.

The comparison of actual costs to these standard costs allows the company to analyze its actual costs and also enables the company to undertake some forms of **controls of the costs**. A large variance between the standard cost and the actual cost is an alert to management that something is possibly wrong and needs attention.

A **standard cost** is not the same thing as a **standard cost system**. A **standard cost** prescribes expected performance in terms of cost. A **standard cost system** is an accounting system that uses standard costs and standard cost variances **in the formal accounting system**. There are other types of accounting systems, and standard costs can be used with those accounting systems as well. In those other types of accounting systems, the standard costs are used for control purposes **outside the formal accounting system**. The emphasis in this section, though, will be on standard cost systems.

A **standard cost system** may be used with either a **process costing system** or a **job-order costing system**. A **process costing system** is used to assign costs to individual products when the products are all relatively similar and are mass-produced, as on an assembly line. **Job-order costing** is a method in which all of the costs associated with a specific job (or client) are accumulated and charged to that job (or client).

Reasons for adopting a standard cost system include:

- It is usually simpler to use standard costs in a process costing system because of the repetitive nature of the operation.
- Use of standard costs in a process cost system make it much easier to determine cost per equivalent unit, because the standard costs serve as the cost per equivalent unit for direct materials, direct labor, and manufacturing overhead.
- Use of standard costs simplifies recordkeeping in either a process costing system or a job-order costing system. Records need to be kept only for quantities on hand. The cost associated with those quantities is simply the standard cost for the period.

Standard costs are best used **with a flexible budgeting system** in order to provide the most useful variance analysis. The flexible budget will enable the company to identify differences from the budget that are not simply due to the actual quantity sold being different from the budgeted quantity sold.

Note: A flexible budget is a budget that is prepared using the standard costs and the actual level of output. It is essentially what the budget would have been if the company had known the actual level of sales at the start of the year. Flexible budgets are covered in much more detail in Section A of this book.

Determining the Level of Activity

Costs are the result of activities that are undertaken to create products or render services. Therefore, it is activities, not costs, that managers manage. Thus, standards should be established for the cost **drivers** underlying the costs.

When determining the **level of activity or production** for the calculation of standard costs, it is important to use the correct level of activity when developing the standards. If the standard level of activity is set too high, there will be no motivation among the workers. This is because they know that no matter how hard they work, they will still fail to meet the budgeted level of output. **Ideal, perfect or theoretical level of output** assumes that there are no breakdowns, no waste and no time lost to illness, and that the workers are already working at maximum efficiency.

An alternative to this theoretical level of output is the **practical, or currently attainable, level of output**. This is the level that will be achieved given the normal amount of time lost, normal amount of waste and a normal learning curve for employees. The goal is to use a level that is attainable, but difficult to attain. This will motivate the workers and still require them to work diligently.

In practice, however, either the **normal level of output** or the **master budget level of output** is used to set the standards. **Normal level** is an average expected level of production within the time frame of several years (up to three) given the reasonable expectations of effective and efficient production and customer demand. **Master budget** capacity is the planned capacity for the next budget period.

In addition to setting the correct level of output, the standard cost also **needs to be reviewed** from the perspective of the costs of the inputs into the process, because it will change over time. If the cost of materials goes up or down, the standard cost must also be adjusted.

Sources of Standards

Appropriate standards are often set by using several sources, including activity analysis, historical data, benchmarking, target costing and strategic decisions.

Activity analysis involves identifying, delineating or outlining, and evaluating all the activities necessary to complete a job, a project or an operation. An activity analysis considers everything required to complete the task efficiently and involves personnel from several areas including engineers, management accountants and production workers. Product engineers specify product components. Industrial engineers analyze the steps or procedures necessary to complete the task. Management accountants work with the engineers to complete the analysis. Activity analysis is time consuming and expensive. However, if properly executed, activity analysis is the most precise way to determine standard costs.

Use of **historical data** is a less costly way to develop standard costs. Historical data for a similar product can be a good source for determining the standard cost of an operation, if reliable information is available. Another advantage to using historical data is that it is based on the way the particular firm has operated in the past. This can also be a disadvantage, because a standard based on the past can perpetuate past inefficiencies. Although historical standards are more attainable than ideal standards, they are not consistent with a philosophy of continuous improvement.

Benchmarking to develop standard costs is based on current practices of similar operations in other firms. Associations of manufacturers often collect industry information and have data available. The firm can use this data as guidelines for setting standard costs. By using benchmarking to set standard costs, a firm can have access to the best performance anywhere and this can help sustain its competitive edge. A disadvantage of using benchmark data is that it might not be completely applicable to the firm's own situation.

Use of **target costing** to set standard costs puts the focus on the market and on the price the product can be sold for. A **target price** is the price the firm can sell its product for, and the **target cost** is the cost that must be attained for the firm to realize its desired profit margin for the product. Once the target cost has been determined, detailed standards are then set to attain the desired cost.

Target costing utilizes the concept of **kaizen**, or continuous improvement, to reduce costs to what is necessary in order to earn the desired profit margin. This takes place through development of new manufacturing methods and techniques, which entails the continuous improvement or ongoing search for new ways to reduce costs. This is the heart of the *kaizen* concept.

Additionally, **strategic decisions** may affect a product's standard cost. For instance, a decision to replace an obsolete machine with a new, computer-controlled machine would require an adjustment to the standard cost for the process. Or a commitment to strive for *kaizen* will require standards to be set at a level that would provide the maximum challenge.

Management by Exception

Once standards have been set, and in a system where variances are identified and reported to the appropriate level of the company, management can **manage by exception**. This means that management can focus time in areas where there are problems, as identified by the fact that there is a variance from the standard. The disadvantage of this method is that negative trends may be overlooked at earlier stages. Also, if too many deviations from the budget occur, this approach can become a very confusing and involved process of trying to fix all of the problems at once.

Question 44: Which one of the following is least likely to be involved in establishing standard costs for evaluation purposes?

- a) Budgetary accountants.
- b) Industrial engineers.
- c) Top management.
- d) Quality control personnel.

(CMA Adapted)

Question 45: A firm most often uses a standard costing system in conjunction with:

- a) Management by objectives.
- b) Target (hurdle) rates of return.
- c) Participative management programs.
- d) Flexible budgets.

(CMA Adapted)

Variance Analysis Concepts

Before looking at the individual variances that are related to the price and usage of labor and materials, we will start by looking at some general variance concepts.

Variances, in general, are a comparison between the budgeted results of the company and the actual results of the company. The more detailed levels of variance analysis determine, to a greater extent, the cause for the difference – i.e., whether the actual quantity was different from the budgeted quantity or the actual price per unit was different from the budgeted price, or whether both were different.

Because of the nature of variances, all of the calculations we make will be a comparison between an actual amount and a budgeted amount. What we are specifically comparing will depend on the variance that we need to calculate.

Note: In this section, the terms “budget” and “standard” are used interchangeably and mean the same thing: a planned amount.

Static Budget Variances Vs Flexible Budget Variances

Recall that a **static budget** is a **fixed budget**. It is a budget that is prepared for one specific level of planned activity, and that level of planned activity does not change, no matter what the actual activity is. A static budget is easy to prepare, but it is not very useful for control and evaluation purposes if the actual level of activity is different from what had been planned. For instance, a cost may be higher than budgeted, but if sales were also higher than expected, the portion of the variance that is due to the increased activity is to be expected and is not a cause for concern.

A more useful and usable budget is a **flexible budget**. This is a budgeted amount that is adjusted to the actual level of activity that has occurred. Flexible budget variances are a better indicator of operating performance than static budget variances are, because they compare **actual results** to the **budgeted results for the actual volume**. If an actual cost is higher than its flexible budget amount, then that variance may be cause for concern.

Static Budget Variances

The first variances we will look at are the most global. The total static budget variances simply compare the static (master) budget against the actual results.

While these variances tell us whether we performed better or worse than budgeted, they do not provide any information as to why that has happened.

Here is an example of a static budget variance report. This report is based upon the income statement. When we move into manufacturing input variances, variance reporting will be concerned with production costs instead of with the income statement.

	Actual Results (1)	Static Budget (2)	Static Budget Variance (3) = (1) - (2)
Units sold	20,000	24,000	4,000– U
Revenues	\$2,500,000	\$2,880,000	380,000– U
<i>Variable costs</i>			
Direct materials	1,243,200	1,440,000	196,800– F
Direct manufacturing labor	396,000	384,000	12,000+ U
Variable manufacturing overhead	<u>261,000</u>	<u>288,000</u>	<u>27,000</u> – F
Total variable costs	<u>1,900,200</u>	<u>2,112,000</u>	<u>211,800</u> – F
Contribution margin	<u>599,800</u>	<u>768,000</u>	<u>168,200</u> – U
Fixed costs	<u>570,000</u>	<u>552,000</u>	<u>18,000</u> + U
Operating income	<u>\$ 29,800</u>	<u>\$ 216,000</u>	<u>\$ 186,200</u> – U

A **favorable variance** is a variance that causes actual net operating income to be higher than the budgeted amount. An **unfavorable variance** is a variance that causes actual net operating income to be lower than the budgeted amount.

Therefore, actual **revenue** that is below budgeted revenue is a negative variance because actual is lower than budget. That is **unfavorable** because it will cause actual net operating income to be lower than the budgeted amount. On the other hand, actual **expenses** that are below budgeted expenses are also negative variances, because actual is lower than budget, but they are **favorable** variances because they will cause actual net operating income to be higher than the budgeted amount.

If net operating income is to be increased, you want revenues to be *higher* than budgeted (a positive variance amount) and you want expenses to be *lower* than budgeted (a negative variance amount). Both of those are favorable variances.

Note: When calculating variances for incomes or expenses, if you **always subtract the Budget amount from the Actual Amount** (such as in the example above), the sign of the variance will always follow these rules:

- A positive variance for an income item is a Favorable variance
- A negative variance for an income item is an Unfavorable variance
- A positive variance for an expense item is an Unfavorable variance
- A negative variance for an expense item is a Favorable variance

$$\text{Actual} - \text{Budget} = \text{Variance}$$

Flexible Budget Variances and Sales Volume Variances

Each of the static budget variances can be further broken down into two subvariances – the flexible budget variance and the sales volume variance.

The **flexible budget variance** is the difference between the actual results and the flexible budget. The flexible budget is **budgeted amounts that have been adjusted to the actual level of activity that has occurred**.

The **sales volume variance** is the difference between the flexible budget amount and the static budget amount.

These variances may be calculated at the level of the income statement as a whole and for each individual item within the income statement.

Example: Here is our example again, this time showing the static budget variances, the flexible budget variances, and the sales volume variances for each line item and for net operating income.

Note that for each line, the flexible budget variance plus the sales volume variance equals the total static budget variance. This is shown for the net operating amounts at the bottom of the report. You should verify the calculation of it for the individual lines, as well, to make sure you understand it.

	Actual results (1)	Flexible budget variances (2)=(1)-(3)	Flexible budget (3)	Sales volume variances (4)=(3)-(5)	Static budget (5)	Static Budget Variances (6)=(1)-(5) ALSO (6)=(2)+(4)
Units sold	20,000	0	20,000	4,000 -U	24,000	4,000 -U
Revenues	\$2,500,000	\$100,000 +F	\$2,400,000	\$480,000 -U	\$2,880,000	380,000 -U
<i>Variable costs</i>						
Direct materials	1,243,200	43,200 +U	1,200,000	240,000 -F	1,440,000	196,800 -F
Direct manufacturing labor	396,000	76,000 +U	320,000	64,000 -F	384,000	12,000 +U
Variable manufacturing overhead	<u>261,000</u>	<u>21,000</u> +U	<u>240,000</u>	<u>48,000</u> -F	<u>288,000</u>	<u>27,000</u> -F
Total variable costs	<u>1,900,200</u>	<u>140,200</u> +U	<u>1,760,000</u>	<u>352,000</u> -F	<u>2,112,000</u>	<u>211,800</u> -F
Contribution margin	<u>599,800</u>	<u>40,200</u> -U	<u>640,000</u>	<u>128,000</u> -U	<u>768,000</u>	<u>168,200</u> -U
Fixed costs	<u>570,000</u>	<u>18,000</u> +U	<u>552,000</u>	<u>0</u>	<u>552,000</u>	<u>18,000</u> +U
Operating income	<u>\$ 29,800</u>	<u>\$ 58,200</u> -U	<u>\$ 88,000</u>	<u>\$ 128,000</u> -U	<u>\$ 216,000</u>	<u>\$ 186,200</u> -U
		\$58,200 U		\$128,000 U		\$186,200 U
		Total flexible budget variance		Total sales volume variance		
						\$186,200 U
						Total static budget variance

Note: On the Exam, you may be asked a question about a variance of any component of a budget. For example, you may be asked to calculate the variable costs flexible budget variance. You simply calculate the difference between the actual and the flexible budget amounts of variable costs and determine whether the variance is favorable or unfavorable.

If a question does not say what line to use, use either the contribution margin line or the operating income line. If the question is asking for the volume variance, the variances on the contribution margin line and the operating income lines will be exactly the same, so it does not matter which line you use. The reason the variances on these two lines are the same is that the volume variance is the difference between the static budget amount and the flexible budget amount. The only difference between the contribution margin line and the operating income line is fixed costs; and fixed costs are exactly the same in the flexible budget as they are in the static budget. Therefore, the volume variance for the contribution margin line will be exactly the same as the volume variance for the operating income line.

As shown on the following pages, we are really most interested in the flexible budget and the flexible budget variances. This is because the sales volume variances are explained simply, by the fact that the actual level of sales was different from the budgeted level of sales. The flexible budget variances, on the other hand, identify variances that are not the result of different-than-expected sales.

In fact, a flexible budget variance for a revenue item is called a **selling price variance**, because it is caused exclusively by differences between the actual selling price and the budgeted selling price.

Types of Variances

Before looking at the different individual variances in greater detail, we will simply list the different variances that we will study. You need to know how to calculate each of these and understand what they tell us when calculated. Additionally, you also must be able to identify what may cause the different variances. The variances that we will look at are:

Manufacturing Input Variances:

Direct Materials Variances

- 1) **Price variance**
- 2) **Quantity or efficiency variance**
 - 2a) **Mix variance***
 - 2b) **Yield variance***

Direct Labor Variance

- 3) **Rate (price) variance**
- 4) **Efficiency (quantity) variance**
 - 4a) **Mix variance***
 - 4b) **Yield variance***

Factory Overhead Variances

- 5) **Total Variable overhead variance**
 - 5a) **Variable overhead spending variance**
 - 5b) **Variable overhead efficiency variance**
- 6) **Total Fixed overhead variance**
 - 6a) **Fixed overhead spending or budget variance**
 - 6b) **Fixed overhead production-volume variance**

Sales Variances:

- 7) **Sales price variance**
- 8) **Sales volume variance**
 - 8a) **Quantity variance****
 - 8b) **Mix variance****

* These specific manufacturing variances are calculated only when there is more than one input (either classes of labor or types of material) into the final product.

** These specific sales variances are calculated when the company sells more than one product.

Manufacturing Input Variances

Manufacturing input variances are a special class of variances, including direct materials, direct labor, and manufacturing overhead used in production. These variances are concerned with **inputs** to the manufacturing process and whether the amount of inputs used per unit manufactured was over or under the standard or whether they cost more or less per unit than the standard, and what the cost impact was of each type of variance. Manufacturing input variances are used in controlling production.

In the accounting system, manufacturing input variances are closed out at the end of each period to cost of sales or, if material, they are prorated among cost of sales and inventories. A variance report like the one you see above will not reflect the exact manufacturing input variances, because the variance report above reflects **sold** units, not manufactured units. The input cost variances for the **sold** units **are** included in the flexible budget variance amount on the above report, because they are included in the Actual Results column which is compared with the Flexible Budget column to calculate a Flexible Budget variance. However, the detail is not there, and they should not be expected to reconcile with a production variance report. A production variance report includes all units produced, whether they were sold or whether they remained in inventory as unsold units at the end of the period.

Before getting into the specific manufacturing input variances, let us think for a moment about the possible reasons for an actual input cost to be different from the standard (i.e., expected or budgeted) cost. The standard cost is determined using an **estimated cost and an estimated level of usage**. It is obvious that if the company either pays a different price than had been budgeted, or uses a different amount than was budgeted for the actual output, the actual cost for the actual output will be different from the budgeted cost for the actual output.

The simple fact that the actual cost is different from the budgeted amount is not, by itself, useful enough for management. Management needs to know **why** the actual cost is different. Is it because **a different amount of raw materials or labor was used than should have been used for the actual output**, or was it because **a different price was paid for the raw materials or labor? Or was it both?** The process of variance analysis will enable management to separate out the specific reason(s) for the variance and then focus its efforts on the areas that have a negative impact on the business – identified by unfavorable variances.

In variance analysis, we subdivide input cost variances into

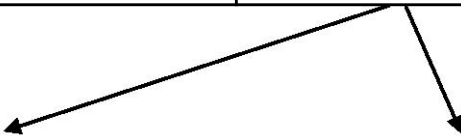
- 1) a **price variance** that reflects the difference between actual and budgeted input **prices** and
- 2) a **quantity variance**, called an **efficiency variance**, that reflects the difference between actual and budgeted input **quantities** used.

If you are able to keep this simple, conceptual understanding of how variances occur, you should find variance analysis questions a little easier.

Summary of Manufacturing Input Variances

The following table summarizes the calculations that we make and the different terms that we use in variance analysis. We will look at all of these in more detail later, and this table is again presented at the end of the section on variances. We have simply included this table at the beginning to help you see what will be covered.

Prime Costs	Price Variance $(AP - SP) \times AQ$	Quantity Variance $(AQ - SQ) \times SP$
Materials	Price Variance	Quantity Variance
Labor	Rate Variance	Efficiency Variance



Multiple Inputs (both Material and Labor)	Mix Variance $(WASPM - WASPSM) \times AQ$	Yield Variance $(AQ - SQ) \times WASPSM$

Variable Overhead	Spending Variance $(AP - SP) \times AQ$	Efficiency Variance $(AQ - SQ) \times SP$
Fixed Overhead	Spending (Budget) Variance Actual OH – Budgeted OH	Production Volume Variance Budgeted OH – Applied OH

Direct Materials Variances

We will start by looking at the variances related to direct materials and their usage.

The **total material variance (also called the flexible budget variance)** is an easy one to calculate. It is the difference between the actual direct materials costs for the period and the standard costs for the standard amount of materials at the standard price per unit **for the level of output actually produced** (the flexible budget).

Example: Paterno Co. produces footballs. Each football requires a standard of 1 square meter of leather that has a standard cost of \$5. During the period, Paterno produced 250 footballs and used 290 meters of leather. The cost of the leather was \$4.50 per meter.

Therefore, the actual total cost of the leather was \$1,305. However, given the actual output of 250 footballs, Paterno should have used only 250 meters. And since each meter should have cost \$5, Paterno should have spent \$1,250 on leather in order to produce 250 footballs.

The total materials variance is:

Actual cost – 290 meters × \$4.50	\$ 1,305
Standard cost – 250 meters × \$5	<u>\$ 1,250</u>
Total variance	<u>\$ 55</u> U

In total, we can see that Paterno spent more money than it should have for the leather to make the footballs. If a manager simply looks at this total variance, the conclusion may be that things are acceptable (it is an unfavorable variance, but it is not that large) and don't require any significant attention. But, when we look in more depth at this example, it is obvious to us that the company used more materials than it should have, but paid less for each square meter of leather than expected. Management will most certainly look at the production process to find out why so much leather was required to make the 250 footballs.

Even though Paterno's total actual cost came close to the total standard cost, there is a significant problem with production. The company either has a very inefficient process that wastes too much leather, or perhaps it has new workers that are not as experienced as they will be in the future. In either case, despite the fact that the total variance cost was close, Paterno needs to investigate further its usage of leather.

Because of the need to have this more useful analysis, the total materials variance is divided into two components – price and quantity. The **price variance** measures how much of the total variance was caused by paying a different amount for the material than had been budgeted, and the **quantity variance (also called the efficiency or usage variance)** measures how much of the variance is due to using more or less of the material than budgeted.

The Quantity Variance

The quantity variance (**also called the efficiency or usage variance**) is calculated as:

$$(\text{Actual Quantity} - \text{Standard Quantity for Actual Output}) \times \text{Standard Price}$$

or

$$(\text{AQ} - \text{SQ}) \times \text{SP}$$

This is simply the difference between the actual material usage and the standard usage for this level of output, multiplied by the standard price. We use the standard price because we are trying to determine what the variance actually is, because we used either too much or too little material, not how much we paid for it. A positive variance is an unfavorable variance, while a negative variance is a favorable variance.

In the example above, the **quantity variance** is calculated as:

$$(290 - 250) \times \$5 = \$200$$

This is an **unfavorable variance** because if the actual price had been the same as the standard price, Paterno would have had to pay \$200 more for the materials it used than it should have, given the number of footballs produced, because it used too much material. The fact that it is unfavorable is indicated by the fact that the number we have calculated is positive. A positive variance for a cost indicates an unfavorable variance, while a negative variance for a cost indicates a favorable variance.

The Price Variance

The price variance is calculated as:

$$(\text{Actual Price} - \text{Standard Price}) \times \text{Actual Quantity}$$

or

$$(\text{AP} - \text{SP}) \times \text{AQ}$$

This measures how much of the variance was due to a difference in the price between what we expected it to be per unit and what it the price paid actually was.

In the example above, the price variance is calculated as:

$$(\$4.50 - \$5) \times 290 = \$ (145)$$

This means that we saved \$145 because the price of the leather was lower than expected. This is a **favorable variance**. Remember that a negative variance for a cost is a favorable variance because it means that actual cost was lower than budgeted cost. So even though Paterno used more leather than it should have for each football it manufactured, it saved \$.50 per meter because the price was lower than expected.

If we take these two variances and add them together, we will have the total materials variance that we first calculated.

Quantity variance	\$ 200	U
Price variance	<u>(145)</u>	F
Total Variance	\$ <u>55</u>	U

In total, Paterno had a positive variance of \$55, which is unfavorable, because the cost for the extra leather that was used was more than the savings on each meter of leather.

Purchase Price Variance

If an Exam question asks for the **purchase** price variance, you calculate this using **all of the units purchased**, not just the units that are put into production. You need to be certain to notice this word if it is used, since it changes your calculation.

One way of looking at these two price variances is as follows: the price variance is calculated at the time of usage, while the **purchase** price variance is calculated at the time of purchase.

Likewise, if a question says that the company recognizes variances **as early as possible**, you would use the **quantity purchased** instead of the quantity used. Most questions ask for the price variance as calculated above, using the units placed into production. But be aware of these possible variations.

Note: On the Exam, you will need to identify possible reasons why a particular variance is favorable or unfavorable. You should usually be able to do this by common sense. For example, an unfavorable quantity variance may be caused by the purchasing department because it bought an inferior product that was damaged or broken, or because of new employees or poor techniques.

In the example above, the variances could be due to the purchasing department getting a good price on inferior leather that was damaged in the production process, or was not always of an acceptable quality.

Accounting for Direct Materials Variances in a Standard Cost System

Standard costing systems use actual variance accounts to record the variances from the standard costs as they occur. At the end of the period, the variances are closed out to cost of goods sold or, if material, prorated among cost of goods sold and inventories.

Purchases of direct materials are recorded as debits to the Materials Inventory account at their **standard cost**. If the company recognizes price variances at the time of purchase, any difference in price from the standard is recorded in a Direct Materials Purchase Price Variance account (a debit if the price is higher than the standard price and a credit if the price is lower than the standard price). The company will probably have a separate variance account for each material used. The credit is to Accounts Payable.

When direct materials are requisitioned from materials inventory for use in the production process, the debit to Work-In-Process Inventory is for the **standard quantity** of materials that should have been used for manufacturing the units manufactured, at their **standard cost**. The credit to the Materials Inventory account is for the **total amount of materials actually used**, at their **standard cost**. The difference is the direct materials quantity variance, and it is recorded in the Direct Materials Quantity (or Usage) Variance account (a debit for an unfavorable variance and a credit for a favorable variance).

This isolates the variances so they can be analyzed. It also maintains standard costs in the Work-In-Process Inventory accounts during the production process.

At the end of the period, the variances are closed out, either to Cost of Goods Sold or, if they are material, they are usually prorated among Work-In-Process Inventory, Finished Goods Inventory, and Cost of Goods Sold.

Question 46: Under a standard cost system, the materials efficiency variances are the responsibility of:

- a) Production and industrial engineering.
- b) Purchasing and industrial engineering.
- c) Purchasing and sales.
- d) Sales and industrial engineering.

(CMA Adapted)

Question 47: A favorable materials price variance coupled with an unfavorable materials usage variance would most likely result from:

- a) Machine efficiency problems.
- b) Product mix production changes.
- c) The purchase and use of higher than standard quality materials.
- d) The purchase of lower than standard quality materials.

(CMA Adapted)

Question 48: Garland Company uses a standard cost system. The standard for each finished unit of product allows for 3 pounds of plastic at \$0.72 per pound. During December, Garland bought 4,500 pounds of plastic at \$0.75 per pound, and used 4,100 pounds in the production of 1,300 finished units of product. What is the materials price variance for the month of December?

- a) \$117 unfavorable.
- b) \$123 unfavorable.
- c) \$135 unfavorable.
- d) \$150 unfavorable.

(CMA Adapted)

The following information is for the next three Questions: ChemKing uses a standard costing system in the manufacture of its single product. The 35,000 units of raw material in inventory were purchased for \$105,000, and 2 units of raw materials are required to produce 1 unit of final product. In November, the company produced 12,000 units of product, which was as budgeted. The standard allowed for material was \$60,000, and there was an unfavorable quantity variance of \$2,500.

Question 49: ChemKing's standard price for one unit of material is:

- a) \$2.00
- b) \$2.50
- c) \$3.00
- d) \$5.00

Question 50: The units of material used to produce November output totaled:

- a) 12,000 units.
- b) 12,500 units.
- c) 23,000 units.
- d) 25,000 units.

Question 51: The materials price variance for the units used in November was:

- a) \$2,500 unfavorable.
- b) \$11,000 unfavorable.
- c) \$12,500 unfavorable.
- d) \$3,500 unfavorable.

(CMA Adapted)

Direct Labor Variances

As with the materials variance, the **total labor variance (also called the flexible budget variance)** is the difference between the standard labor costs for the actual level of output (the flexible budget) and the actual costs incurred by the company. Also similar to the materials variance, this total variance is attributable to variances in both labor rates and labor usage. This means that the company either paid a different wage rate than standard or used a different number of labor hours than standard for this level of output, or both.

Because this is so similar to variance analysis for materials, we will not cover it in detail again, but the total labor variance can be broken down into the labor rate variance (a price variance) and the labor efficiency variance (a quantity variance). These are calculated in the exact same manner as the direct material cost and usage variances, but simply have different names.

The Labor Rate Variance

The labor rate variance is calculated as the direct materials price variance was calculated:

$$(\text{Actual Rate} - \text{Standard Rate}) \times \text{Actual Hours}$$

or

$$(\text{AP} - \text{SP}) \times \text{AQ}$$

The Labor Efficiency Variance

The labor efficiency variance is calculated the same way as the direct materials quantity variance was calculated:

$$(\text{Actual Hours} - \text{Standard Hours for Actual Output}) \times \text{Standard Rate}$$

or

$$(\text{AQ} - \text{SQ}) \times \text{SP}$$

Note: On the Exam, you need to be able to use these formulas not only to solve for the variance itself, but also to solve for any of the individual variables in these equations. In this second case, you will be given the variance and asked to solve for one of the quantity or price numbers, either actual or standard. This is simply using the same formulas, but solving for a different variable.

Accounting for Direct Labor Variances in a Standard Cost System

The production payroll is recorded by debiting Work-In-Process Inventory for the total number of **standard hours for the units manufactured** at the **standard hourly rate**. The credit is to accrued payroll at the **total number of hours actually spent** and at the **actual hourly rate**. The difference is recorded in the Direct Labor Rate Variance (the price variance) and the Direct Labor Efficiency Variance (the quantity variance) accounts. Unfavorable variances are debits, and favorable variances are credits.

As with direct materials variances, the variances are closed out at the end of the period, either to Cost of Goods Sold or, if they are material, prorated among Work-In-Process Inventory, Finished Goods Inventory, and Cost of Goods Sold.

Note: The company must also choose how the costs of employee related costs such as employee benefits and payroll taxes will be treated. They may be included in the cost of direct labor or treated as an overhead and allocated to the units produced. In some cases, these costs may be treated as a period cost. The method in which these costs are treated may have a small effect on cost of goods sold, income or inventory. Only in cases where direct labor is a large portion of the total expenses will this difference be significant.

Question 52: An unfavorable direct labor efficiency variance could be caused by a(n):

- a) Unfavorable variable overhead spending variance.
- b) Unfavorable materials usage variance.
- c) Unfavorable fixed overhead volume variance.
- d) Favorable variable overhead spending variance.

(CMA Adapted)

Question 53: Under a standard cost system, labor price variances are usually not attributable to:

- a) Labor rate predictions.
- b) The use of a single average standard rate.
- c) Union contracts approved before the budgeting cycle.
- d) The assignment of different skill levels of workers than planned.

(CMA Adapted)

Question 54: Price variances and efficiency variances can be key to the performance measurement within a company. In evaluating performance, all of the following can cause a materials efficiency variance except the:

- a) Performance of the workers using the material.
- b) Actions of the purchasing department.
- c) Design of the product.
- d) Sales volume of the product.

(CMA Adapted)

Question 55: A company set the total budgeted direct labor cost at \$75,000 for the month for producing 5,000 units. The following standard cost, stated in terms of direct labor hours (DLH), was used to develop the budget for direct labor cost:

$$1.25 \text{ DLH} \times \$12.00/\text{DLH} = \$15.00/\text{unit produced}$$

The actual operating results for the month were as follows:

Actual units produced	5,200
Actual direct labor hours worked	6,600
Actual direct labor cost	\$77,220

The direct labor efficiency variance for the month would be:

- a) \$4,200 unfavorable.
- b) \$3,000 unfavorable.
- c) \$2,220 unfavorable.
- d) \$1,200 unfavorable.

(CIA Adapted)

The following information is for the next three Questions: Jackson Industries employs a standard cost system that carries direct materials inventory at standard cost. Jackson has established the following standards for the prime costs of one unit of product:

	<u>Standard Quantity</u>	<u>Standard Price</u>	<u>Standard Cost</u>
Direct Materials	5 pounds	\$3.60 per pound	\$18.00
Direct Labor	1.25 hours	\$12.00 per hour	\$15.00
			\$33.00

During May, Jackson purchased 125,000 pounds of direct material at a total cost of \$475,000. The total factory wages for May were \$364,000, 90% of which were direct labor. Jackson manufactured 22,000 units of product during May, using 108,000 pounds of direct materials and 28,000 direct labor hours.

Question 56: The direct materials usage (quantity) variance for May is:

- a) \$7,200 unfavorable.
- b) \$7,600 favorable.
- c) \$5,850 unfavorable.
- d) \$7,200 favorable.

Question 57: The direct labor price (rate) variance for May is:

- a) \$8,400 favorable.
- b) \$7,200 unfavorable.
- c) \$8,400 unfavorable.
- d) \$6,000 unfavorable.

Question 58: The direct labor usage (efficiency) variance for May is:

- a) \$5,850 favorable.
- b) \$6,000 unfavorable.
- c) \$5,850 unfavorable.
- d) \$6,000 favorable.

(CMA Adapted)

More than One Material Input or One Labor Class

What has been outlined above is the variance analysis process when we have only one material input into the product or only one class of labor (a class of labor is nothing more than a different wage rate).

In situations where there is a **mix of materials (or labor)** that goes into the product (such as for dog food or cereal), there will be a total variance, a price variance, and a quantity variance. In addition, the quantity variance is subdivided into a **mix variance** and a **yield variance**. The **mix variance** tells us how much of the quantity variance was caused by the fact that the actual **mix** that was used was different from the standard mix (i.e., more of one ingredient was used and less of another ingredient was used). The **yield variance** tell us how much of the quantity variance was caused by the fact that the **total** actual amount of all ingredients used was different from the **total** standard amount.

The price variance of a weighted mix is not broken down the way the quantity variance is.

The mix of ingredients is called a **weighted mix**.

Total Variance of a Weighted Mix

The **total variance** of a weighted mix is the **Total Actual Cost** minus the **Total Standard Cost**.

This and the following variance calculations will be illustrated in an example that follows this discussion.

Materials Price Variance or Labor Rate Variance of a Weighted Mix

The price variance of a weighted mix is the sum of the price variances for each component of the mix, each one calculated individually, using the formula $(AP - SP) \times AQ$.

So if the product manufactured has more than one material input or more than one labor rate, a price variance is calculated for each separate input, and the individual price variances are added together to calculate the total price variance.

Total Material Quantity or Labor Efficiency Variance of a Weighted Mix

The **total** material quantity or labor efficiency variance of a weighted mix is the sum of the quantity variances for each component of the mix, each one calculated individually.

The formula $(AQ - SQ) \times SP$ is used to calculate the quantity variance for each component of the mix separately, and then the individual quantity variances are added together to calculate the total quantity variance.

We then break down this total material quantity or labor efficiency variance into two subvariances – the **mix** and the **yield variances**.

The Mix Variance (Materials or Labor)

The mix variance is the part of the quantity variance that results because the mix of materials actually used or the mix of the labor used was different from the mix that should have been used (i.e., the standard). An example would be including more corn and less wheat in the cereal than the standard calls for.

This can occur if there is not enough of a specific input and substitutes were required, or if the wrong proportions were accidentally used in the product.

The formula used to calculate the mix variance is a variation of the **price variance** formula: $(AP - SP) \times AQ$. But instead of using the actual and standard prices for the input, we use **weighted average standard prices**. We use:

- 1) The **weighted average standard price of the actual mix**. We calculate this as the **actual quantity used for each input** multiplied by the **standard cost** for each input, and then adding the results; and

- 2) The **weighted average standard price of the standard mix**. This is calculated as the **standard quantity of each input for the actual output** multiplied by the **standard cost** for each input, and then adding the results.

This is demonstrated with numbers in the example following the explanations of these subvariances. (It is not as bad as it sounds.)

The mix variance is calculated as follows:

$$\left(\begin{array}{l} \text{Weighted Average Standard Price of the} \\ \text{Actual Mix} - \text{Weighted Average Standard} \\ \text{Price of the Standard Mix (both calculated} \\ \text{using the Standard Costs)} \end{array} \right) \times \text{Actual Quantity of all} \\ \text{material or labor inputs}$$

or

$$(\text{WASPAM} - \text{WASPSM}) \times \text{AQ}$$

Note: When looking at any mix variances, it is essential that responsibility be given to an individual only if the person actually has control over the mix, or the substitutions, used.

The Yield Variance (Material or Labor)

The yield variance results from the difference between the **total actual quantity** of the inputs that were actually used to produce the actual output and the **total standard quantity** that should have been used to produce the actual output.

The formula to calculate the yield variance is a variation of the **quantity variance** of the mix, or $(\text{AQ} - \text{SQ}) \times \text{SP}$. Instead of using the standard price of a single input, we use the **weighted average standard price of the standard mix**.

The yield variance is calculated as follows:

$$\left(\begin{array}{l} \text{Actual Total Quantity of All Inputs} - \\ \text{Standard Total Quantity of All Inputs} \end{array} \right) \times \text{Weighted Average Standard Price} \\ \text{of Standard Mix of All Inputs}$$

or

$$(\text{AQ} - \text{SQ}) \times \text{WASPSM}^b$$

Note: In the formula above, the actual quantity of input to the product (AQ) is equal to the **total** number of all of the pounds or hours (or whatever else) that **actually was used** to produce the actual level of output.

The standard quantity of input to the product (SQ) is equal to the **total** number of all of the pounds or hours (or whatever else) that **should have been used** to produce the actual level of output.

Note: Remember, if there is only one input to the product, there is no need to calculate these two additional variances.

On the following two pages is a full example of the calculation of the total variance, the price variance, the quantity variance, and the materials mix and yield variances of a weighted mix.

^b This is the same WASPSM as was used in the calculation of the mix variance.

Example: Using the following information, calculate the material price and quantity variances, and also the material mix and yield subvariances.

A company produces cereal made up of different grains. The material prices in effect for the fiscal year ending June 30 and the standard kg allowed for the output of April are:

	<u>Standard Price/Kg</u>	<u>Standard Kg for Output</u>	<u>Standard Cost</u>
Corn	\$10.00	250	\$2,500.00
Wheat	\$ 8.00	250	2,000.00
Rice	\$ 3.00	250	750.00
		<u>750</u>	<u>\$5,250.00</u>

Due to various natural disasters around the world, the price for each input increased on January 1. The standard prices were not revised, and the actual output in April was the same as planned.

The actual material prices and the actual usage for April were as follows:

	<u>Actual Price</u>	<u>Actual Usage</u>	<u>Actual Cost</u>
Corn	\$12.00	375	\$4,500.00
Wheat	\$ 8.50	200	1,700.00
Rice	\$ 5.50	325	1,787.50
		<u>900</u>	<u>\$7,987.50</u>

Total Variance

The total variance is the difference between the **standard cost for the actual level of output** and the **actual cost**. The standard cost for April was \$5,250. The actual cost for April was \$7,987.50. This gives a **total unfavorable variance of \$2,737.50**, which is broken down into the price and the quantity variances as below.

Materials Price Variance

This is calculated by determining the price variance for each of the three products individually and adding them together. The formula $(AP - SP) \times AQ$ and the 3 calculations are:

Corn	$(\$12 - \$10) \times 375$	=	\$ 750.00
Wheat	$(\$8.50 - \$8) \times 200$	=	100.00
Rice	$(\$5.50 - \$3) \times 325$	=	812.50

Total Materials Price Variance **\$1,662.50**

Total Materials Quantity Variance

The total materials quantity variance is calculated by using the usage formula $(AQ - SQ) \times SP$ for each of the classes individually and then adding them all together:

Corn	$(375 - 250) \times \$10$	=	\$ 1,250.00
Wheat	$(200 - 250) \times \$8$	=	(400.00)
Rice	$(325 - 250) \times \$3$	=	225.00

Total Materials Quantity Variance **\$1,075.00**

At this point, we can do a simple test of the two main variances. The price variance added together with the quantity variance should equal the total variance. In this case, that is true: $(\$1,662.50 + \$1,075.00 = \$2,737.50)$.

From this point, we need to calculate the mix variance and the yield variance, and when those two items are added together, they must equal \$1,075, the total material quantity variance.

Mix Variance

We will start with the **Mix Variance**. What we are calculating here is how much of the material quantity variance was a result of the actual mix that was used being different from the standard mix. We do this by comparing the weighted average standard prices of the actual and standard quantities of each material input, using the standard price for each input. We then multiply this difference by the actual total quantity of all inputs used. The formula for this is:

$$(\text{WASPAM} - \text{WASPSM}) \times \text{AQ}$$

The **Weighted Average Standard Price of the Standard Mix (WASPSM)** is calculated as follows:

$$\text{Total Standard Cost} \div \text{Total Standard Kgs}$$

The total standard kilograms is 750 and the total standard cost is calculated as follows:

Corn	250 × \$10	=	\$2,500
Wheat	250 × \$ 8	=	2,000
Rice	250 × \$ 3	=	<u>750</u>

Total Standard Cost 750 kg \$5,250

This will make the **Weighted Average Standard Price of the Standard Mix (WASPSM)** **\$7.00 per kg** (\$5,250 ÷ 750).

The **Weighted Average Standard Price of the Actual Mix (WASPAM)** is calculated as follows:

$$\text{Total Cost using Actual Kg and Standard Price} \div \text{Total Actual Kg.}$$

The total actual kg was 900 and the total standard cost of the actual mix is calculated as follows:

Corn	375 × \$10	=	\$3,750
Wheat	200 × \$ 8	=	1,600
Rice	325 × \$ 3	=	<u>975</u>

Total Cost at Standard Rate 900 kg \$6,325

This will make the **Weighted Average Standard Price of the Actual Mix (WASPAM)** **\$7.0277 per kg** (\$6,325 ÷ 900).

This tells us that because the mix was wrong, the standard price of each kilogram of actual input used was \$.0277 more than it should have been.

Putting all of these numbers into the formula (WASPAM – WASPSM) × AQ we get the following:

$$(\$7.0277 - \$7.00) \times 900 = \text{\$25 Unfavorable Materials Mix Variance}$$

\$25 of the unfavorable quantity variance arose because the mix that was used was not the correct mix.

Yield Variance

We now need to calculate the **Materials Yield Variance**, which calculates how much of the quantity variance occurred as a result of using more or less total input than the standard total input. In this calculation, we are not worried about the mix of the inputs, just the total quantity of inputs used. The formula for this is:

$$(\text{AQ} - \text{SQ}) \times \text{WASPSM}$$

We already know the WASPSM was \$7 per kg from the previous calculations, the Actual Quantity was 900 kg, and the Standard Quantity was 750 kg.

Putting all of this into the formula we get the following:

$$(900 - 750) \times \$7 = \text{\$1,050 Unfavorable Materials Yield Variance}$$

This means that \$1,050 of the unfavorable quantity variance was caused by the fact that we used more material input than we should have for the amount of output. From these calculations, we see that it was not so much the change in the mix that caused the variance, but rather a general inefficiency in the use of the material inputs.

To prove all of the calculations, we can do a simple check comparing the two subvariances to the total quantity variance:

	Materials Mix Variance	\$ 25 U
+	Materials Yield Variance	<u>1,050 U</u>
=	Total Materials Quantity Variance	<u>\$1,075 U</u>

The following information is for the next two Questions: Azat Corporation produces ketchup. Azat mixes two varieties of tomatoes: a locally grown variety to provide excellent taste and an imported variety to provide a richer color. The standard costs and inputs for a 200-kg batch of ketchup are as follows:

<u>Tomato Type</u>	<u>Standard Quantity in Kg.</u>	<u>Standard Cost per Kg</u>	<u>Total Cost</u>
Local	200	.75	\$150
Imported	<u>100</u>	.90	<u>90</u>
Total	<u>300</u>		<u>\$240</u>

A total of 110 batches were produced during the current period. The quantities actually purchased and used during the current period as well as the prices paid are shown below:

<u>Tomato Type</u>	<u>Quantity in Kg.</u>	<u>Actual Cost per Kg</u>	<u>Total Cost</u>
Local	21,000	.65	\$13,650
Imported	<u>14,000</u>	.95	<u>13,300</u>
Total	<u>35,000</u>		<u>\$26,950</u>

Question 59: What is the materials mix variance for the current period?

- a) \$1,050 favorable
- b) \$350 favorable.
- c) \$1,050 unfavorable.
- d) \$350 unfavorable.

Question 60: What is the materials yield variance for the current period?

- a) \$1,600 favorable.
- b) \$1,600 unfavorable.
- c) \$1,620 unfavorable.
- d) \$1,620 favorable.

(HOCK)

Factory Overhead Variances

In this section we are looking at the calculation of the variances related to factory overhead. Unfortunately, these are a little more difficult for most people to logically “see” what is happening. If this is the case for you, simply memorize the formulas for these calculations. They are very similar to the formulas used for labor and material variances.

There are both variable and fixed overhead variances. We will look first at the variable overhead variances and then at the fixed overhead variances. Both of these two general variances can be broken down into two variances, as we did for the material and labor variances.

As such, there are actually four total variances that are calculated for overhead.

These four variances are then combined into what are known as four-way, three-way and two-way analysis. The different methods are simply different combinations of the same four variances. We will start by looking at the four variances individually, and then look at the different combinations.

Variable Overhead Variances

Total Variable Overhead Variance (or Variable Overhead Flexible Budget Variance)

Variable overheads are overhead costs that change as the level of production changes. Examples are plant electricity, equipment maintenance, utilities, etc. They cannot be traced to specific units manufactured, and for that reason they are called overhead costs. However, since they do increase when production increases and decrease when production decreases, they are variable costs.

The total variable overhead variance is equal to the difference between the actual variable overhead incurred and the standard variable overhead applied. The standard variable overhead applied is based on the standard usage (given the actual output) of the overhead allocation base (machine hours, direct labor hours, etc). This is also called the **variable overhead flexible budget variance**.

$$\begin{aligned} & \text{Actual Total Variable Overhead Incurred (money spent on these items)} \\ & - \text{Flexible Budget Amount}^c \\ & = \text{Total Variable Overhead Variance}^d \end{aligned}$$

This total variance may be broken down into the spending and efficiency variances.

Variable Overhead Spending Variance

This is essentially the price variance and this variance is related to the difference between the actual variable overhead cost per unit (this is calculated as the actual overhead costs ÷ the actual usage of the allocation base) and the standard application rate. The variable overhead spending variance is calculated as follows:

$$\begin{aligned} & \left(\begin{array}{l} \text{Actual VOH Cost Per Unit of} \\ \text{Allocation Base Actually Used} - \\ \text{Standard VOH Cost Per Unit of} \\ \text{Allocation Base [i.e., Standard} \\ \text{Application Rate]} \end{array} \right) \times \begin{array}{l} \text{Actual Quantity of VOH Allocation Base} \\ \text{Used for Actual Output} \end{array} \\ & \text{or} \\ & (\text{AP} - \text{SP}^e) \times \text{AQ} \end{aligned}$$

^c This is calculated as (Standard Rate × Standard Quantity for the Actual Production Level).

^d Note that this is the same as the amount of over- or underapplied variable overhead.

^e Note that this is really not a price, but rather a rate. We use the letter P in this formula to keep it the same as in the materials and labor variances since the formulas are essentially the same.

This variance is also the difference between the **actual amount of variable overhead incurred** and the **standard amount of variable overhead allowed for the actual quantity of the VOH allocation base used for the actual output produced.**

Variable Overhead Efficiency Variance

This is essentially the quantity variance, and it determines the amount of the total variance caused by a different usage of the allocation base than was expected (i.e., the standard hours for the actual output).

The variable overhead efficiency variance is calculated as follows:

$$\begin{array}{l} \text{(Actual Activity Level of VOH} \\ \text{Allocation Base Used for Actual} \\ \text{Output} - \text{Standard Activity Level of} \\ \text{VOH Allocation Base Allowed for} \\ \text{Actual Output)} \end{array} \times \text{Standard Application Rate}$$

or, what is essentially

$$(AQ - SQ) \times SP$$

Note: If overhead is applied based on amount of the allocation base used for the actual units of output rather than a standard amount allowed, there will be no variable overhead efficiency variance.

Question 61: The following information pertains to Roe Co.'s June operations:

Standard direct labor hours per unit	2
Actual direct labor hours	10,500
Number of units produced	5,000
Standard variable overhead per standard direct labor hour	\$3
Actual variable overhead	\$28,000

Roe's June unfavorable variable overhead efficiency variance was:

- a) \$0
- b) \$1,500
- c) \$2,000
- d) \$3,500

(CPA Adapted)

Fixed Overhead Variances

Total Fixed Overhead Variance

The total fixed overhead variance analysis is the difference between the actual fixed overhead and the amount that was applied using the standard rate and the standard usage for the actual level of output.

$$\begin{aligned}
 & \text{Actual Fixed Overhead Incurred (money actually spent)} \\
 & - \text{Applied Fixed Overheads (standard rate} \times \text{standard for actual output)}^f \\
 & = \text{Total Fixed Overhead Variance}^g
 \end{aligned}$$

As with the variable overhead variance, this total fixed overhead variance can be broken down into two other variances – spending (or budget) variance and volume variance.

Fixed Overhead Spending (or Fixed Overhead Budget) Variance

The fixed overhead budget/spending variance is simply the difference between the actual fixed overhead costs and the budgeted fixed overhead amount.

$$\begin{aligned}
 & \text{Actual Fixed Overhead Incurred} \\
 & - \text{Budgeted Fixed Overheads (the static budget amount)} \\
 & = \text{Fixed Overhead Budget/Spending Variance}
 \end{aligned}$$

Fixed Overhead Production-Volume Variance

The fixed overhead volume variance is the difference between the budgeted amount of fixed overhead and the amount of fixed overhead applied (standard rate $\times$ **standard input for the actual level of output**). The Fixed Overhead Production-Volume Variance is caused by the actual production level being different from the production level used to calculate the budgeted fixed overhead rate. This is done mathematically as follows:

$$\begin{aligned}
 & \text{Budgeted Fixed Overheads (the static budget amount)} \\
 & - \text{Applied amount of Fixed Overhead (standard rate} \times \text{standard input for actual output)} \\
 & = \text{Fixed Overhead Production-Volume Variance}
 \end{aligned}$$

Note: This is the only time for an expense variance calculation that a budgeted cost amount comes before an actual cost amount, and yet a negative amount is Favorable. This variance is different because it does not measure a difference between an actual incurred cost and a budgeted cost. A negative amount is Favorable because it indicates that **actual production has exceeded the budgeted production level**. A positive amount is Unfavorable because it indicates that **actual production has been lower than the budgeted production level**.

As we can see, the Total Fixed Overhead Variance is equal to the Fixed Overhead Budget/Spending Variance plus the Fixed Overhead Production-Volume Variance.

Note: There is no fixed overhead efficiency variance because these costs do not relate to levels of output and therefore cannot be used efficiently or inefficiently.

Following is an example of variable, fixed, and total overhead variance calculations. In addition to this example, you will find a comprehensive example of accounting for fixed overhead and fixed overhead variances in Section C of this textbook under the topic of "The Process of Accounting for Factory Overhead." The example in the next section will highlight fixed overhead and show how the fixed overhead variances

^f Overhead is applied to individual products produced, usually on the basis of either direct labor hours, machine hours, materials costs, units of production, weight of production, or some other similar measure. This will be covered in depth in Section C, Cost Management. The "standard for actual output" in the formula is the **standard amount of the application base allowed for the actual output**.

^g This amount is the same as the over- or under-applied fixed factory overhead.

arise in the accounting system and how they are cleared out. The fixed overhead example in Section C will use the same amounts as this example does for fixed overhead, so it will maintain continuity.

Example: Overhead is applied to production based on machine hours. Before 2010 begins, the company budgets the following for the year 2010:

Standard for number of machine hours used/unit produced	5 MH/unit
Budgeted activity level	1,000,000 units
Budgeted fixed overhead	\$10,000,000
Budgeted fixed overhead application rate	
$\$10,000,000 \div (5 \text{ MH/unit} \times 1,000,000 \text{ units})$	\$2/MH
Budgeted variable overhead for budgeted activity level	\$5,000,000
Budgeted variable overhead application rate	
$\$5,000,000 \div (5 \text{ MH/unit} \times 1,000,000 \text{ units})$	\$1/MH

Actual production during 2010 is 1,200,000 units. The **standard** number of machine hours (the machine hours **allowed** for the actual production) is 1,200,000 units $\times$ 5 MH per unit, or 6,000,000 machine hours. The **actual** number of machine hours used during 2010 for the actual production is 6,300,000 hours.

During 2010, fixed and variable overhead is applied to production at the predetermined rates of \$2 per machine hour **allowed** for fixed overhead and \$1 per machine hour **allowed** for variable overhead, for a total of \$3 per machine hour allowed. Since 6,000,000 machine hours were allowed for the actual production of 1,200,000 units, the total amount of fixed overhead applied is $\$2 \times 6,000,000$, or \$12,000,000; and the total amount of variable overhead applied is $\$1 \times 6,000,000$, or \$6,000,000. Total fixed and variable overhead applied is $\$12,000,000 + \$6,000,000$, or \$18,000,000.

Actual overhead incurred during 2010:

Fixed overhead	\$11,000,000
Variable overhead	<u>5,670,000</u>
Total actual overhead incurred	\$16,670,000

Budgeted overhead for 2010:

Fixed overhead	\$10,000,000
Variable overhead ($\$1/\text{MH} \times 5\text{MH/unit} \times 1,200,000 \text{ units produced}$)	<u>6,000,000</u>
Total budgeted overhead, fixed and variable	\$16,000,000

Total overhead variance (Total actual OH – Total budgeted OH) \$ 670,000 Unfavorable

Variable Overhead Variances

Total Variable OH Variance:

Actual Total Variable OH incurred	\$5,670,000
Minus: VOH Applied: standard rate $\times$ standard qty. of application base (machine hours) allowed for actual output ($\$1 \times 5 \times 1,200,000$)	<u>6,000,000</u>
Total Variable Overhead Variance	<u>\$ (330,000)</u> Favorable

The total variable overhead variance is broken down into the **variable overhead spending variance** and the **variable overhead efficiency variance**.

(continued)

Variable Overhead Spending Variance:

$$\left[\begin{array}{l} \text{Actual VOH cost/unit of allocation base actually used} \\ \text{Minus standard VOH application rate/unit of allocation base} \end{array} \right] \times \begin{array}{l} \text{Actual Qty. of VOH} \\ \text{application base used for} \\ \text{actual output} \end{array}$$

$$\text{OR } (AP - SP) \times AQ$$

$$[(\$5,670,000 \div 6,300,000) - \$1] \times 6,300,000 = (.90 - 1.00) \times 6,300,000 = \underline{\underline{\$(630,000) \text{ Favorable}}}$$

Variable Overhead Efficiency Variance:

$$\left[\begin{array}{l} \text{Actual activity level of VOH application base actually used} \\ \text{Minus standard activity level of application base allowed} \end{array} \right] \times \text{Standard Application Rate}$$

$$\text{OR } (AQ - SQ) \times SP$$

$$[6,300,000 - (1,200,000 \times 5)] \times \$1 = (6,300,000 - 6,000,000) \times \$1 = \underline{\underline{\$300,000 \text{ Unfavorable}}}$$

The Variable Overhead Spending Variance of \$(630,000) Favorable plus the Variable Overhead Efficiency Variance of \$300,000 Unfavorable equals the Total Variable Overhead Variance of \$(330,000) Favorable.

The variance analysis tells us that the actual variable overhead cost per unit of the allocation base (machine hours) incurred was lower than budgeted for the amount actually produced (\$630,000 Favorable); but the number of units of the allocation base (machine hours) actually used was higher than budgeted (\$300,000 Unfavorable).

Fixed Overhead Variances**Total Fixed Overhead Variance:**

Actual fixed overhead incurred	\$11,000,000
Minus: Applied fixed overhead (standard rate × standard quantity of applic. base for actual output, or \$2 × 6,000,000 MH)	<u>12,000,000</u>
Total fixed overhead variance	<u>\\$(1,000,000) Favorable</u>

The total fixed overhead variance is broken down into the **fixed overhead spending variance** and the **fixed overhead production-volume variance**.

Fixed Overhead Spending Variance:

Actual fixed overhead incurred	\$11,000,000
Minus: Budgeted Fixed Overhead	<u>10,000,000</u>
Total fixed overhead variance	<u>\\$1,000,000 Unfavorable</u>

Fixed Overhead Production-Volume Variance:

Budgeted Fixed Overhead	\$10,000,000
Minus: Applied fixed overhead (standard rate × standard quantity of applic. base for actual output, or \$2 × 6,000,000 MH)	<u>12,000,000</u>
Fixed overhead production-volume variance	<u>\\$(2,000,000) Favorable</u>

The Total Fixed Overhead Variance is the \$1,000,000 Unfavorable spending variance plus the \$2,000,000 Favorable production-volume variance, or \$1,000,000 Favorable. The unfavorable spending variance means more fixed overhead was actually incurred than was budgeted. The favorable production-volume variance means that actual production exceeded the budgeted production level.

(continued)

Although the actual production level exceeded the budgeted production level, the actual fixed overhead cost incurred did not increase because of the increased production, since the cost is fixed. The total fixed cost was spread over a greater number of units, and that is favorable. However, the actual fixed overhead cost incurred **was** higher than had been budgeted (though not due to the increased production), and that was unfavorable.

The total variable overhead variance of \$(330,000) Favorable plus the total fixed overhead variance of \$1,000,000 Unfavorable is equal to the total overhead variance we calculated at the beginning of this example of \$670,000 Unfavorable.

Question 62: The total fixed overhead variance is the:

- a) Measure of the lost profits from the lack of sales volume.
- b) Amount of the underapplied or overapplied fixed overhead costs.
- c) Potential cost reduction that can be achieved from better cost control.
- d) Measure of production inefficiency.

(CMA Adapted)

Question 63: Variable overhead is applied on the basis of standard direct labor hours. If the direct labor efficiency variance is unfavorable, the variable overhead efficiency variance will be:

- a) Favorable.
- b) Unfavorable.
- c) The same amount as the labor efficiency variance.
- d) Indeterminable because it is not related to the labor efficiency variance.

(CMA Adapted)

Two-Way, Three-Way and Four-Way Analysis

What we have covered above is the analysis of overheads (fixed and variable) in the four-way method. There are four variances and each is calculated separately. There are also three-way and two-way methods of analyzing overheads, which we do by simply combining some of the four-way analysis variances that we calculated.

In **Three-way Analysis**, the three variances are the volume, efficiency and spending variances.

- 1) The **volume variance** is equal to the volume variance as calculated for fixed overhead.
- 2) The **efficiency variance** is equal to the variable overhead efficiency variance.
- 3) The **spending variance** is equal to the variable overhead spending variance **plus** the fixed overhead spending (budget) variance.

Two-way Analysis uses the same information as calculated for four-way analysis, but we are going to combine it in a slightly different manner. The two variances are called the volume variance and the controllable (or budget) variance.

- 1) The **volume variance** is equal to the volume variance for fixed overhead.
- 2) The **controllable variance** is equal to the sum of the remaining three variances, which are variable spending variance, variable efficiency variance and fixed spending (budget) variance.

The following table illustrates the way the four variances are combined for three-way and two-way analysis.

Variable Overhead Variance Analysis		Fixed Overhead Variance Analysis	
Efficiency Variance (AQ – SQ) × SP	Spending Variance (AP – SP) × AQ	Spending (Budget) Variance Actual – Budgeted	Production Volume Variance Budgeted – Applied
Efficiency Variance	Spending Variance		Volume Variance
Controllable Variance			Volume Variance

Question 64: Which of these variances is least significant for cost control?

- a) Labor price variance.
- b) Materials quantity variance.
- c) Fixed O/H volume variance.
- d) Variable O/H spending variance.

(CMA Adapted)

The following information is for the next six Questions: Franklin Glass Works' production budget for the year ended November 30 was based on 200,000 units. Each unit required two standard hours of labor for completion. Total overhead was budgeted at \$900,000 for the year, and the fixed overhead rate was estimated at \$3.00 per unit. Both fixed and variable overhead are assigned to the product on the basis of direct labor hours. The actual data for the year ended November 30 is presented as follows.

Actual production in units	198,000
Actual direct labor hours	440,000
Actual variable overhead	\$352,000
Actual fixed overhead	\$575,000

Question 65: The standard hours allowed for actual production for the year ended November 30 total:

- a) 247,500
- b) 396,000
- c) 400,000
- d) 495,000

Question 66: Franklin's variable overhead efficiency variance for the year is:

- a) \$33,000 unfavorable.
- b) \$35,520 favorable.
- c) \$66,000 unfavorable.
- d) \$33,000 favorable.

Question 67: Franklin's variable overhead spending variance for the year is:

- a) \$20,000 unfavorable.
- b) \$19,800 favorable.
- c) \$22,000 unfavorable.
- d) \$20,000 favorable.

Question 68: Franklin's fixed overhead spending variance for the year is:

- a) \$19,000 favorable.
- b) \$25,000 favorable.
- c) \$5,750 favorable.
- d) \$25,000 unfavorable.

Question 69: The fixed overhead applied to Franklin's production for the year is:

- a) \$484,200.
- b) \$575,000.
- c) \$594,000.
- d) \$600,000.

Question 70: Franklin's fixed overhead volume variance for the year is:

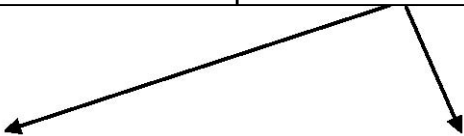
- a) \$6,000 unfavorable.
- b) \$19,000 favorable.
- c) \$25,000 favorable.
- d) \$55,000 unfavorable.

(CMA Adapted)

Summary Table of Variance Calculations

The following table summarizes the calculations that are made and the different terms used in variance analysis.

Prime Costs	Price Variance $(AP - SP) \times AQ$	Quantity Variance $(AQ - SQ) \times SP$
Materials	Price Variance	Quantity Variance
Labor	Rate Variance	Efficiency Variance



Multiple Inputs^h (both Material and Labor)	Mix Variance $(WASPAM - WASPSM) \times AQ$	Yield Variance $(AQ - SQ) \times WASPSM$

Variable Overheadⁱ	Spending Variance $(AP - SP) \times AQ$	Efficiency Variance $(AQ - SQ) \times SP$
Fixed Overhead	Spending (Budget) Variance Actual OH – Budgeted OH	Production Volume Variance Budgeted OH – Applied OH

^h The sum of the mix and yield variance is equal to the total of the quantity or efficiency variance for each of the inputs calculated separately, and then added together.

ⁱ For overhead variances, we use the standard and actual application rate rather than price. The standard rate is the rate that is calculated at the beginning of the year and used to allocate overhead, and the actual rate is calculated as Actual Costs / Actual Level of Usage.

Sales Variances

Variance analysis is used to assess the selling department as well as the production department. We know logically that if actual revenue is different from budgeted revenue, it may be because we either sold more or less than we expected or because the selling price was higher or lower than expected. And, as we saw in variance analysis of manufacturing costs, it may be a combination of both of these reasons.

Sales variances are used to explain the differences between actual and budgeted amounts of revenue, variable costs, and contribution margin caused by differences between actual sales results and planned or budgeted sales results. These variances can be calculated for revenues, variable cost, and contribution margin, because those are affected by the amount of each product that is sold, the price each unit is sold for, and the cost of each unit sold.

The variances can be caused by differences in sales price charged, by differences in volume of sales, by differences in variable cost per unit, and by differences in the mix of products sold.

These variances are called **sales variances** to differentiate them from the manufacturing input variances we talked about in the previous section. These variances can be calculated for every variable line on the variance report — not just the Sales (i.e., Revenue) line.

Furthermore, these sales variances use the term **price**. If we are analyzing a revenue line, then **price** means selling price per unit. But if we are analyzing the contribution margin line, then **price** means the contribution margin per unit. And if we are analyzing the variable cost line, then **price** means variable cost per unit.

Note: Many of the sales variances are actually calculated using **contribution margin per unit** instead of sales price per unit, because we want to analyze the effect of sales on net operating income, and we assume that variable costs will move in line with sales while fixed costs will remain constant. Contribution margin equals **sales price – variable costs**.

However, sales variances are also calculated individually for every line on a variance report: revenue, variable costs, contribution margin, and so forth. On an exam, it is critical to read the question carefully to make sure you know what is called for. **If it is not specified, use the contribution margin.**

To illustrate sales variances, let's repeat our variance analysis report example from the beginning of this section. We will begin with the company selling just one product.

Variance Report for a SINGLE Product Company

	Actual results (1)	Flexible budget variances (2)=(1)-(3)	Flexible budget (3)	Sales volume variances (4)=(3)-(5)	Static budget (5)	Static Budget Variances (6)=(1)-(5) ALSO (6)=(2)+(4)
Units sold	20,000	0	20,000	4,000 -U	24,000	4,000 -U
Revenues	\$2,500,000	\$100,000 +F	\$2,400,000	\$480,000 -U	\$2,880,000	380,000 -U
Variable costs						
Direct materials	1,243,200	43,200 +U	1,200,000	240,000 -F	1,440,000	196,800 -F
Direct manufacturing labor	396,000	76,000 +U	320,000	64,000 -F	384,000	12,000 +U
Variable manufacturing overhead	<u>261,000</u>	<u>21,000</u> +U	<u>240,000</u>	<u>48,000</u> -F	<u>288,000</u>	<u>27,000</u> -F
Total variable costs	<u>1,900,200</u>	<u>140,200</u> +U	<u>1,760,000</u>	<u>352,000</u> -F	<u>2,112,000</u>	<u>211,800</u> -F
Contribution margin	<u>599,800</u>	<u>40,200</u> -U	<u>640,000</u>	<u>128,000</u> -U	<u>768,000</u>	<u>168,200</u> -U
Fixed costs	<u>570,000</u>	<u>18,000</u> +U	<u>552,000</u>	<u>0</u>	<u>552,000</u>	<u>18,000</u> +U
Operating income	<u>\$ 29,800</u>	<u>\$ 58,200</u> -U	<u>\$ 88,000</u>	<u>\$ 128,000</u> -U	<u>\$ 216,000</u>	<u>\$ 186,200</u> -U
		\$58,200 U		\$128,000 U		\$186,200 U
		Total flexible budget variance		Total sales volume variance		
		\$186,200 U				
		Total static budget variance				

Since this company sells only one product, we have calculated the Flexible Budget column by taking the Static Budget amount, dividing by the Static Budget Units Sold, and multiplying by the Actual Results Units Sold. Remember that the Flexible Budget is what the budget would have been at the beginning of the year if the budget had been prepared using the actual level of sales. This means that the total revenue and variable costs will be different in the flexible budget than in the static budget, but total fixed costs will be the same in both budgets.

Example: Using the table above, the Flexible Budget Revenue is $\$2,880,000 \div 24,000 \times 20,000$, or $\$2,400,000$. (Note: The Flexible Budget can be calculated in this manner **only** when the company sells a single product, as we shall see later.)

Note: When we looked at variances for manufacturing input costs, the Flexible Budget variance was broken down into price and quantity variances. However, when we look at sales variances, there is no quantity variance in the flexible budget variance.

This is because in calculating sales variances, we use reported results for units **sold**, not units manufactured. Manufacturing input variances are closed out at the end of the period to cost of sales or, if material, are pro rated between cost of sales and inventory.

Therefore, the actual results we use for the sales variances report have already been adjusted to include the manufacturing input variances. So for the cost lines on the sales variance report, the flexible budget variances (variances between actual results and the flexible budget amounts) incorporate both the price and the quantity manufacturing input variances as simply the flexible budget cost variances. On this report, the Flexible Budget variances on cost lines are "price" variances only (i.e., calculated as price variances, but using cost as the "P" in the formula), since the quantities used in calculating the Flexible Budget amounts are the same as the actual quantities sold.

The extra layer of variance breakdown caused by having paid more for inputs per unit and having used more than the standard quantity per unit does not appear on the sales variance report. Any variance on the sales variance report that is due to quantity is due to variance in the quantity of **product sold**, not to variance in the quantity of **manufacturing inputs used**.

Sales Variances for a Single Product Firm

Sales Price Variance for a Single Product Firm (Flexible Budget Variance)

The Sales Price Variance is the same as the Flexible Budget Variance. They are simply two names for the same thing. The Flexible Budget Variances measure the difference between the actual results and the flexible budget amounts. Remember that the flexible budget is an adjusted budget, where all variable incomes and expenses have been adjusted to reflect the actual sales volume in terms of units sold, and this means that the difference between the actual results and the flexible budget is caused only by a difference between the standard and the actual price, not a difference between actual and budgeted quantity.

The Actual Revenue amount in the variance report above is \$2,500,000, and the actual number of units sold is 20,000. Therefore, the actual average sales price per unit is $\$2,500,000 \div 20,000$, or \$125. The Static Budget Revenue amount is \$2,880,000, and the static budget number of units sold is 24,000. Thus, the budgeted average sales price per unit is $\$2,880,000 \div 24,000$, or \$120.

In the variance report, the Revenue amount in the Flexible Budget column is \$2,400,000. This is the **budgeted** selling price of \$120 multiplied by the **actual** units sold of 20,000.

The flexible budget variance for revenue is Actual Revenue of \$2,500,000 minus Flexible Budget Revenue of \$2,400,000, or \$100,000 Favorable.

The Sales Price Variance/Flexible Budget Variance can also be calculated using our general variance formula for the **Price Variance**:

$$(\text{AP} - \text{SP}) \times \text{AQ}$$

Thus, the Price Variance (the flexible budget variance for revenues), using the actual and budgeted selling prices, is

$$(\$125 - \$120) \times 20,000 = \$100,000 \text{ F}$$

And that is the same as the Flexible Budget Variance for the Revenue line on the variance report.

Remember that the Sales Price Variance can be calculated using the above Price Variance formula for every variable line on the variance report, not only the Revenue line. For the variable cost line, use the actual and standard per unit costs as the "AP" and "SP" in the Price Variance formula. If you are analyzing the contribution margin line, the "AP" and "SP" to use in the formula are the actual contribution margin per unit (actual price minus actual cost) and standard contribution margin per unit (standard price minus standard cost).

Note: If actual results are being compared to the flexible budget (instead of to the static budget), the **only** cause of variances will be variances in price, because **the flexible budget volume and the actual volume will be the same**. That is the reason why the Sales Price Variance is the same as the Flexible Budget Variance.

Sales Volume Variance for a Single Product Firm

The Sales Volume Variance measures the impact of the difference in sales volume between **actual results** and the **STATIC budget**.

Note: If a static budget is not used for variance reporting and **only a flexible budget is used** to make the comparisons to actual results, there will be **no Sales Volume Variance**, because the actual units sold will be equal to the budgeted units sold according to the flexible budget. There can be a Sales Volume Variance only when the actual results are compared to the static budget.

Notice in the variance report above that, in addition to the column "Flexible Budget Variances," there is one column called "Sales Volume Variances" and another column called "Static Budget Variances."

The Sales Volume Variance measures the difference between the Static Budget amount and the Flexible Budget amount for each line. For example, the Static Budget amount for Revenues is \$2,880,000, based on sales of 24,000 units at \$120. However, only 20,000 units were actually sold, although the actual selling price was \$125 instead of \$120.

Therefore, the Flexible Budget amount for Revenue is \$2,400,000, which is the actual number of units sold of 20,000 multiplied by the budgeted selling price of \$120. Thus, the Sales Volume Variance for Revenue is \$(480,000) Unfavorable, which is the **Flexible Budget amount of \$2,400,000 minus the Static Budget amount of \$2,880,000**.

For a single product firm, the Sales Volume Variance can also be calculated for each variable income and expense item (and the contribution margin) on the variance report as a Quantity Variance, using our general Quantity Variance formula:

$$(AQ - SQ) \times SP$$

Using amounts from the variance report, we would calculate the **Sales Volume Variance for revenue** as:

$$(20,000 - 24,000) \times \$120 = \$ (480,000) \text{ U}$$

Since this is an income item, a negative variance is an Unfavorable variance, because it means Revenue was lower than budgeted and thus Net Operating Income was lower.

Summary of Single Product Variances

- For a single product firm, the Flexible Budget Variances are due to differences in prices, and the Sales Volume Variances are due to differences in quantity.
- When comparing **actual results** to the **static budget**, the Flexible Budget Variances are due to price while the Sales Volume Variances are due to quantity.
- When comparing **actual results** to the **flexible budget**, there will be no Sales Volume/Quantity Variance (i.e., the variance will be zero). This is because the quantity in the flexible budget is the same as the actual quantity.
- The Flexible Budget Variance plus the Sales Volume Variance equals the Static Budget Variance.

On the variance report, the Static Budget Variance for Revenue is \$(380,000) Unfavorable. This is made up of a \$100,000 Favorable Flexible Budget (**Price**) Variance and a \$(480,000) Unfavorable Sales Volume (**Quantity**) Variance. This means that the actual price received for the units sold was higher than planned, leading to a favorable \$100,000 Sales Price Variance; but the quantity of units sold was lower than planned, leading to an unfavorable \$(480,000) Sales Volume Variance. Together, the two variances net to the Static Budget Variance of \$(380,000) Unfavorable.

Like the Sales Price Variance, the Sales Volume Variance can be calculated for every variable line on the variance report using the above Quantity Variance formula. For variable costs, use the standard per unit cost as the "SP" in the Price Variance formula. If you are analyzing the contribution margin line, the "SP" to use in the formula is the standard contribution margin per unit (standard price minus standard cost).

If on an exam you are given a variance report that includes an operating income line and asked only what the Sales Volume Variance is, however, the question is probably asking for the "bottom line," or the Sales Volume Variance for operating income. There are two ways to calculate this. One is to calculate the Sales Volume Variance for the contribution margin. That will be the same as the Sales Volume Variance for operating income (since there can be no Sales Volume Variance for fixed costs). Or a second way is to simply subtract the **Static Budget Operating Income** from the **Flexible Budget Operating Income**.

Sales Variances When MORE THAN ONE Product is Sold

Thus far, we have assumed that our example company sells only one product. Now, we will change that to assume it sells two products, Product A and Product B.

When more than one product is sold, we will have a **Sales Price Variance** (the **Flexible Budget Variance**) similar to what we had for a single product firm, although it will be calculated differently. Furthermore, the **Sales Volume Variance** will be subdivided into a **Sales Mix Variance** and a **Sales Quantity Variance**. This will be similar to what was done for manufacturing input variances when there was more than one input into the product.

Do not let the similar names for these variances confuse you. There are slightly different terms for a single product firm and a multiple product firm.

The **Sales Quantity Variance** for a multi-product firm is calculated in a different way from the way the **Sales Volume (Quantity) Variance** is calculated for a single product firm.

Furthermore, although the **Sales Price Variance** for a multi-product firm is also the **Flexible Budget Variance** like it is for a single product firm, it is calculated differently for a multi-product firm.

The breakdown of the Sales Volume Variance into the Sales Quantity Variance and the Sales Mix Variance when a company sells more than one product is done in the same way as was done with manufacturing costs when there was more than one input.

Before we can do that, though, the flexible budget for our company needs to be changed slightly to include more than one product. To develop the Flexible Budget dollar amounts, we cannot simply take the Static Budget dollar amounts, divide them by the total number of units budgeted to be sold and multiply by the number of units actually sold. That can be done when there is only one product being sold, but not when there is more than one product.

Instead, we need to develop new flexible budget amounts for revenues, variable costs and the contribution margin, based on the individual sales prices and individual variable costs for each product, and the effect that the change in each one's sales volume has on those amounts as components of the total. The flexible budget amounts will be calculated individually for each product sold, using the actual quantity sold and the budgeted price/cost per unit and then summed to get the line that appears on the variance report.

Note: Just as was true with the single product firm, **when the flexible budget is used** to make the comparisons to actual results, there will be **no Sales Volume Variance**, because the actual units sold will be equal to the budgeted units sold according to the flexible budget. For the multi-product firm, the flexible budget amounts are calculated for each product individually using the actual number of units sold of each product and the budgeted price of each product, and then those amounts are summed to get the flexible budget amounts for the whole company.

There can be a Sales Volume Variance only when the actual results are compared to the *static* budget, for both the single product firm and the multi-product firm. If actual results are compared to the *flexible* budget, the Sales Volume Variance is always zero.

So here is our variance report again with those changes. The amounts on the statement that have changed are enclosed in boxes. (The details behind the Revenue line are given on the page following the variance report, but the details behind the other lines are not presented here for simplicity.)

Variance report for a company selling TWO PRODUCTS

	Actual results (1)	Flexible budget variances (2)=(1)-(3)	Flexible budget (3)	Sales volume variances (4)=(3)-(5)	Static budget (5)	Static Budget Variances (6)=(1)-(5) ALSO (6)=(2)+(4)
Units sold	20,000	0	20,000	4,000 -U	24,000	4,000 -U
Revenues	\$2,500,000	\$125,000 +F	\$2,375,000	\$505,000 -U	\$2,880,000	380,000 -U
Variable costs	<u>1,900,200</u>	<u>160,200</u> +U	<u>1,740,000</u>	<u>372,000</u> -F	<u>2,112,000</u>	<u>211,800</u> -F
Contrib margin	599,800	35,200 -U	635,000	133,000 -U	768,000	168,200 -U
Fixed costs	<u>570,000</u>	<u>18,000</u> +U	<u>552,000</u>	<u>0</u>	<u>552,000</u>	<u>18,000</u> +U
Oper income	<u>\$ 29,800</u>	<u>\$ 53,200</u> -U	<u>\$ 83,000</u>	<u>\$ 133,000</u> -U	<u>\$ 216,000</u>	<u>\$ 186,200</u> -U
		\$53,200 U		\$133,000 U		\$186,200 U
		Total flexible budget variance		Total sales volume variance		
						\$186,200 U
						Total static budget variance

Notice that the total Static Budget Variance is still the same: \$186,200 U. However, the **flexible budget amounts** for Revenues, Variable Costs and Contribution Margin have changed; and therefore, the Flexible Budget Variances and Sales Volume Variances for those lines have also changed.

On the next page is a Detail Schedule for Revenue, showing the detail behind the Revenues line on the Variance Report above for a company selling two products. Note that the total number of units sold and Total Revenue amounts for the actual results, static budget and flexible budget match the amounts on the Variance Report above. Note also on the Detail Schedule presented next that the weighted average Revenues per unit for the actual results and the static budget match the budgeted and actual prices we calculated earlier, when we simply divided Total Revenue by the number of units sold. However, here we will also calculate a weighted average Revenue per unit for the Flexible Budget; and that is a different figure.

The numbers that appear on the Revenue line of the variance report on the previous page appear on this Detail Schedule in bold face.

Detail Schedule for Revenue line on variance report for a company selling two products:				
	Revenue Per Unit (Sales Price)	# Units Sold	Total Revenue	Weighted Avg Price Per Unit (Tot Rev/ Tot # Units)
<u>ACTUAL RESULTS</u>				
Total Revenue:				
Product A	\$122	12,500	\$1,525,000	
Product B	\$130	<u>7,500</u>	<u>975,000</u>	
		20,000	\$2,500,000	\$125.00
			(Rev line, column 1 on Variance Report)	
<u>FLEXIBLE BUDGET (budgeted sales prices per unit, actual # sales)</u>				
Total Revenue:				
Product A	\$115	12,500	\$1,437,500	
Product B	\$125	<u>7,500</u>	<u>937,500</u>	
		20,000	\$2,375,000	\$118.75
			(Rev line, column 3 on Variance Report)	
<u>STATIC BUDGET</u>				
Total Revenue:				
Product A	\$115	12,000	\$1,380,000	
Product B	\$125	<u>12,000</u>	<u>1,500,000</u>	
		24,000	\$2,880,000	\$120.00
			(Rev line, column 5 on Variance Report)	

Sales Price Variance (Flexible Budget Variance) for a Multi-Product Firm

The Sales Price Variance for the Revenue line measures how much of the variance between the actual Total Revenue and the static budget Total Revenue was due to the actual sales prices for each product being different from their planned sales prices.

We calculate the Sales Price Variance for a multi-product firm **by calculating each product's individual sales price variance and summing them**, as follows:

The **Sales Price Variance** for the Total Revenue line is:

$$\Sigma (AP - SP) \times AQ$$

Or

$$\text{For Product A: } (\$122 - \$115) \times 12,500 = \$87,500 \text{ F}$$

$$\text{For Product B: } (\$130 - \$125) \times 7,500 = \underline{\underline{37,500}} \text{ F}$$

$$\text{Total Price Variance} \quad \underline{\underline{\$125,000}} \text{ F}$$

This tells us that of the total Static Budget Variance of \$(380,000) Unfavorable for Revenues, \$125,000 Favorable was due to the fact that the actual sales prices for both products were higher than what was budgeted.

Note: As before, the Sales Price Variance is also the Flexible Budget Variance. You can confirm this by looking at the Variance Report for the company selling two products. You will see the \$125,000 F in the Flexible Budget Variance column on the Revenue line.

This Sales Price Variance/Flexible Budget Variance for Revenue is unrelated to sales volume. It is strictly the portion of the total variance that is caused by the fact that the sales prices received for the units sold were different from the budgeted sales prices. Since the Static Budget Variance is an Unfavorable \$(380,000), we know that something else must have impacted the revenue line very unfavorably, to cause it to go from \$125,000 Favorable to \$(380,000) Unfavorable. We will see what it was in the Sales Volume Variance, which comes next.

The Sales Price Variance can be calculated for every variable line on the variance report, not just for Revenue. If you are calculating it for a multi-product firm for the variable cost line, the "AP" and "SP" to use in the formula for each product are the actual cost and standard cost per unit. If you are calculating it for the contribution margin line, the "AP" and "SP" to use in the formula for each product are the actual contribution margin per unit (actual price per unit minus actual cost per unit) and the standard contribution margin per unit (standard price per unit minus standard cost per unit).

Sales Volume Variances for a Multi-Product Firm

As was the case when looking at more than one factory input, when we are selling more than one item, we calculate the total **Sales Volume Variance** for a multi-product firm by determining the Sales Volume Variance for each product individually and then adding up the individual variances. This total Sales Volume Variance will in turn be broken down into two sub-variances – the **Sales Quantity Variance** and the **Sales Mix Variance**.

To calculate the total Sales Volume Variance for the Revenue line, we use the actual number of units sold for each product (AQ), the standard (budgeted) number of units to be sold for each product (SQ), and the standard (budgeted) sales price for each product (SP). You can find these numbers on the Detail Schedule for Revenue above. For Product A, the AQ is 12,500 units and the SQ is 12,000 units. For Product B, the AQ is 7,500 units and the SQ is 12,000 units. The standard prices, also on the Detail Schedule, are \$115 for Product A and \$125 for Product B.

$$\Sigma (AQ - SQ) \times SP$$

Or

$$\text{For Product A: } (12,500 - 12,000) \times \$115 = \$57,500 \text{ F}$$

$$\text{For Product B: } (7,500 - 12,000) \times \$125 = \underline{(562,500)} \text{ U}$$

Total Sales Volume Variance

$$\underline{\underline{\$(505,000) \text{ U}}}$$

This tells us that even though the sales prices we received were higher than budgeted, the sales of Product B were significantly below the budgeted amount of 12,000 units. Sales of Product A were slightly above the budgeted amount of 12,000 units, but not enough to offset the unfavorable variance in Product B sales. The result was a total Sales Volume Variance of \$(505,000) Unfavorable.

The Favorable Sales Price Variance of \$125,000 and the Unfavorable Sales Volume Variance of \$(505,000) together net to the total Static Budget Variance of \$(380,000) Unfavorable.

Note that like the other sales variances, the Sales Volume Variance can be calculated for every variable line on the variance report, not just for Revenue. If you are calculating it for a variable cost line, the "SP" to use in the formula for each product is the standard cost per unit. If you are calculating it for the contribution margin line, the "SP" to use in the formula for each product is the standard contribution margin per unit (standard price minus standard cost).

For a multi-product firm, the Sales Volume Variance is subdivided into the **Sales Quantity Variance** and the **Sales Mix Variance**. These sub-variances will tell us how much of the \$(505,000) Unfavorable Sales Volume Variance was caused by the fact that, in total, the **number of units sold** was different from what was budgeted and how much was caused by the fact that the **mix of products sold** was different from the budgeted mix.

Note: Once again, do not get confused by terms that seem to be the same. The Sales Quantity Variance for a multi-product firm is a different variance from the Sales Volume (Quantity) Variance for a single product firm.

Furthermore, although the Sales Price Variance for a multi-product firm is also the Flexible Budget Variance and this is true for a single product firm as well, remember that it is calculated differently for a multi-product firm.

Sales Quantity Variance for a Multi-Product Firm

The Sales Quantity Variance measures the effect of the difference between the **actual total units sold of all products** and the **budgeted total units sold of all products**. It does not take into consideration variances due to differences in the mix of products sold.

To calculate the Sales Quantity Variance for a multi-product firm, we use our quantity variance formula, but we use the **weighted average standard price for the standard mix (WASPSM)** in the formula as the standard price. That amount appears in the Detail Schedule for Revenue above as the weighted average price per unit in the Static Budget. It is \$120. The AQ and SQ are also on the Detail Schedule. AQ is 20,000 units, and SQ is 24,000 units.

The **Sales Quantity Variance** formula is:

$$(AQ - SQ) \times WASPSM$$

The Sales Quantity Variance for the Revenue line is:

$$(20,000 - 24,000) \times \$120 = \underline{\underline{\$(480,000) \text{ U}}}$$

You will notice that this is the same amount as the Sales **Volume** Variance when our firm was a single product firm. However, this is not the same amount as the Sales **Volume** Variance when our firm became a multi-product firm. Recall that we calculated the Sales Volume Variance for the multi-product firm above as \$(505,000) Unfavorable.

The reason that the Sales **Quantity** Variance for the multi-product firm is the same as the Sales **Volume** Variance for the one product firm is that the Sales Quantity Variance is not affected by the fact that this company has more than one product. The Sales Quantity Variance analyzes only the effect of the differences between actual and budget in terms of **total units sold**, regardless of what products were sold.

The Sales Quantity Variance tells us that because this company planned to sell 24,000 units of both products and sold only 20,000 units of both products, its actual Total Revenue for all units sold was lower than the static budget by \$480,000, which was unfavorable.

Like the other variances we are talking about here, the Sales Quantity Variance can also be calculated for every variable line on the variance report, not just for Revenue. If you are calculating it for a variable cost line, you would calculate the weighted average standard variable cost for the standard mix to use as WASPSM in the formula. And if you are calculating it for the contribution margin line, you would calculate the weighted average standard contribution margin for the standard mix to use as WASPSM in the formula.

The Sales Mix Variance, which we will talk about next, incorporates the impact of the difference between the actual product mix sold and the budgeted product mix and its effect on the line we are analyzing, which is Total Revenue.

Sales Mix Variance for a Multi-Product Firm

If sales for a multi-product firm occur in different proportions than was planned for, and if the planned sales prices for the various products are different from one another, there will be a Sales Mix Variance for the Total Revenue line. The Sales Mix Variance measures the effect of the difference between the proportions of total units sold represented by each product as planned versus what actually occurred.

Just as we did with the manufacturing mix variance, we will use WASPAM (the weighted average standard price for the actual mix) and WASPSM (the weighted average standard price for the standard mix) in calculating the Sales Mix Variance for the Revenue line.

We have already calculated the weighted average standard price for the actual mix (WASPAM) in the Detail Schedule for Revenue above, under the Flexible Budget heading. It is \$118.75. We also have calculated the weighted average standard price for the standard mix (WASPSM), under the Static Budget heading. It is \$120.

The **Sales Mix Variance** formula is:

$$(WASPAM - WASPSM) \times AQ$$

The Sales Mix Variance for Revenue is:

$$(\$118.75 - \$120.00) \times 20,000 = \underline{\underline{\$(25,000) \text{ U}}}$$

Product A was planned to represent only 50% of the sales, but it actually represented 62.5% of sales (12,500 units divided by the total sales of 20,000 units). The price for Product A was planned to be lower than the price for Product B (\$115 for Product A and \$125 for Product B). Because Product A, with the lower planned sales price, made up more than the planned amount of 50% of actual sales, the variance in Total Revenue caused by this difference from the budget was an Unfavorable \$(25,000).

The Sales Mix Variance and the Sales Quantity Variance together make up the Sales Volume Variance when more than one product is sold. The Sales Mix Variance is \$(25,000) Unfavorable, and the Sales Quantity Variance is \$(480,000) Unfavorable. Together, they total to the Sales Volume Variance of \$(505,000) Unfavorable.

This tells us that of the \$(505,000) Unfavorable Sales Volume Variance, \$(25,000) Unfavorable of it was caused by the fact that the actual mix of sales differed from the budgeted mix of sales; and \$(480,000) Unfavorable of it was caused by the fact that sales in total of all units were lower than budgeted.

Total Sales Variance for a Multi-Product Firm

We now have the three variances that together, make up the causes of the **static budget variance** in the Total Revenue line, which in our variance report for a multi-product firm is \$(380,000) Unfavorable. They are:

Sales Price Variance	\$ 125,000 F
Sales Quantity Variance	(480,000) U
Sales Mix Variance	<u>(25,000) U</u>
Static Budget Variance	<u><u>\\$(380,000) U</u></u>

Notice that the Sales Quantity Variance plus the Sales Mix Variance are equal to the Sales Volume Variance for the Revenue line on the variance report for the multi-product firm; and the Sales Price Variance is equal to the Flexible Budget Variance for the Revenue line. Recall that the Flexible Budget Variance measures the causes for variances due to factors **other than** a variance in total units sold.

Remember that all of these variances can be calculated for every variable line on a variance report, in just the same way as we have analyzed the Revenue line.

Sales variances use the term **price**. If we are analyzing the revenue line, then **price** means selling price per unit. If we are analyzing a variable cost line, then **price** means variable cost per unit. And if we are analyzing the contribution margin line, then **price** means the contribution margin per unit.

Also, remember that if we are analyzing a variable cost line, a **negative** variance is a **Favorable** variance and a **positive** variance is an **Unfavorable** variance. This is the opposite of the way negative and positive variances are interpreted for the Revenue and the Contribution Margin lines.

Variances Example Using Contribution Margin

Here is another example. This example has no connection with the variance report and examples we have been using up to this point. This example analyzes the contribution margin line.

Example: A newly created firm produces chairs and tables. The budgeted sales data for the first month of operation follows (CM stands for contribution margin per unit):

	<u>Budgeted CM</u>	<u>Actual CM</u>	<u>Budgeted Units</u>	<u>Actual Units</u>
Chairs	\$ 6	\$ 5	15	10
Tables	\$25	\$30	6	5

Calculation of the Total Sales Price Variance for the contribution margin:

The total Sales Price Variance is the sum of the price variances for each item. The Sales Price Variance for each item is calculated as $(AP - SP) \times AQ$, and so the total Sales Price Variance is $\Sigma (AP - SP) \times AQ$. (Remember that P is actually contribution margin for this analysis.)

The total Sales Price Variance for the contribution margin is then found by adding together the individual Sales Price Variances for the contribution margins of each product, as follows:

For chairs	$(\$5 - \$6) \times 10$	=	(10) U
For tables	$(\$30 - \$25) \times 5$	=	<u>25</u> F
Total Sales Price Variance			<u>\$15</u> F

This means that the company was \$15 better off (\$15 more contribution) because the actual contribution margin per unit was more than was expected.

Calculation of the Total Sales Volume Variance

First, the total Sales Volume Variance is calculated individually for each item and then these amounts are added together. The formula to use is $\Sigma (AQ - SQ) \times SP$. The Sales Volume Variance calculation for the contribution margin is as follows:

For chairs	$(10 - 15) \times \$6$	=	(30) U
For tables	$(5 - 6) \times \$25$	=	<u>(25)</u> U
Total Sales Volume Variance			<u>\$(55)</u> U

This means that the company was \$55 worse off (\$55 less contribution) due to selling fewer items than budgeted. This \$55 must be broken down to determine if the problem was in the mix of what was sold, meaning that the total number of units sold was acceptable, but they were not the budgeted numbers of each product (the Sales Mix Variance), or if it was simply that not enough units were sold (the Sales Quantity Variance), or both.

Calculation of the Sales Quantity Variance

The sales quantity variance for a multi-product firm is equal to $(AQ - SQ) \times WASPSM$. In other words, this is the difference between actual total quantity sold and budgeted total quantity, multiplied by the weighted average standard CM per unit for the standard sales mix (WASPSM). In order to solve this, we first calculate the weighted average standard contribution margin for the standard sales mix (WASPSM).

The computation of the weighted average standard CM per unit for the standard sales mix is as follows:

Total budgeted contribution margin for chairs is	\$6 × 15	=	90
Total budgeted contribution margin for tables is	\$25 × 6	=	<u>150</u>
<i>Total budgeted contribution margin</i>			<u>\$240</u>

Given that a total of 21 items were budgeted to be sold, the weighted average standard contribution margin per unit for the standard mix (WASPSM) is \$11.43 (\$240 ÷ 21). This means that if we asked a manager at the beginning of the year to provide the average budgeted contribution from the sale of one "average" unit, the answer would be \$11.43.

The total quantity actually sold and the total quantity budgeted are 15 and 21, respectively. Putting these items into the formula, we get:

$$(15 - 21) \times \$11.43 = \$ (68.60), \text{ or a } \mathbf{\$68.60 \text{ Unfavorable Quantity Variance}}$$

This means that the company's contribution margin was lower than budgeted by \$68.60 because it simply did not sell enough units.

Calculation of the Sales Mix Variance

The formula that we will use is (WASPAM – WASPSM) × AQ. This is the difference between the weighted average standard contribution margin for the **actual** mix and the weighted average standard contribution margin for the **standard** mix, multiplied by the total quantity of units actually sold.

We have already calculated the weighted average standard contribution margin for the standard mix (WASPSM), so all we need to do now is calculate the weighted average standard contribution margin for the actual mix (WASPAM), as follows:

Total contribution margin for actual chairs sold at the standard contribution margin per unit is	\$6 × 10	=	60
Total contribution margin for actual tables sold at the standard contribution margin per unit is	\$25 × 5	=	<u>125</u>
Total contribution margin for actual sales at standard contribution			<u>\$185</u>

Given that in total 15 items were actually sold, the weighted average standard contribution margin per unit for the actual mix (WASPAM) is \$12.33 (\$185 ÷ 15). This means that if we asked a manager at the end of the year what the budgeted contribution was from one "average" unit sold, the answer would be \$12.33.

Putting these items into the formula, we get:

$$(\$12.33 - \$11.43) \times 15 = \$13.60, \text{ or a } \mathbf{\$13.60 \text{ Favorable Sales Mix Variance.}}$$

This means that because the company sold a mix that was actually more heavily weighted to the higher contribution item (tables), it received \$13.60 more contribution than if the actual quantity sold had been sold in the planned mix.

Unfortunately for the company, the low quantity sold was more of a factor than the good mix sold, and so the company had an unfavorable total Sales Volume Variance. Recall that the total Sales Volume Variance was \$(55.00) Unfavorable.

To check our work, we can add the \$(68.60) Unfavorable Sales Quantity Variance and the \$13.60 Favorable Sales Mix Variance. The sum is \$(55.00) Unfavorable. This is the same as the total Sales Volume Variance.

Question 71: Actual and budgeted information about the sales of a product are presented for June as follows.

	<u>Actual</u>	<u>Budget</u>
Units	8,000	10,000
Sales Revenue	\$92,000	\$105,000

The sales price variance for June was:

- a) \$8,000 favorable.
- b) \$10,000 favorable.
- c) \$10,000 unfavorable.
- d) \$10,500 unfavorable.

(CIA Adapted)

Question 72: The following exhibit reflects a summary of performance for a single item of a retail store's inventory for April.

	<u>Actual Results</u>	<u>Flexible Budget Variances</u>		<u>Flexible Budget</u>	<u>Static (Master) Budget</u>
Sales (units)	<u>11,000</u>	<u>--</u>		<u>11,000</u>	<u>12,000</u>
Revenue (sales)	\$208,000	\$12,000	Unfav.	\$220,000	\$240,000
Variable costs	<u>121,000</u>	<u>11,000</u>	Unfav.	<u>110,000</u>	<u>120,000</u>
Contribution margin	\$ 87,000	\$23,000	Unfav.	\$110,000	\$120,000
Fixed costs	<u>72,000</u>	<u>--</u>		<u>72,000</u>	<u>72,000</u>
Operating income	<u>\$ 15,000</u>	<u>\$23,000</u>	Unfav.	<u>\$ 38,000</u>	<u>\$ 48,000</u>

The sales volume variance is:

- a) \$1,000 favorable.
- b) \$10,000 unfavorable.
- c) \$11,000 favorable.
- d) \$12,000 unfavorable.

(CIA Adapted)

The following information is for the next two Questions: Clear Plus, Inc. manufactures and sells boxes of pocket protectors. The static budget and the actual results for May are:

	<u>Actual</u>	<u>Static Budget</u>
Unit Sales	12,000	10,000
Sales	\$132,000	\$100,000
Variable cost of sales	<u>70,800</u>	<u>60,000</u>
Contribution Margin	61,200	40,000
Fixed Costs	<u>32,000</u>	<u>30,000</u>
Operating Income	<u>\$ 29,200</u>	<u>\$ 10,000</u>

Question 73: The flexible budget operating income for Clear, using a flexible budget for May is:

- a) \$12,000
- b) \$19,200
- c) \$30,000
- d) \$18,000

Question 74: Which one of the following statements concerning Clear's actual results for May is correct?

- a) The flexible budget variance is \$8,000 favorable.
- b) The sales price variance is \$32,000 favorable.
- c) The sales volume variance is \$8,000 favorable.
- d) The flexible budget variable cost variance is \$10,800 unfavorable.

(CMA Adapted)

Question 75: The following data is available for July. What is the sales quantity variance for the contribution margin for July?

	<u>Budget</u>	<u>Actual</u>
Sales	40,000 units	42,000 units
Selling price	\$6 per unit	\$5.70 per unit
Variable cost	\$3.50 per unit	\$3.40 per unit

- a) \$5,000 favorable.
- b) \$4,600 favorable.
- c) \$12,000 unfavorable.
- d) \$12,600 unfavorable.

(CIA Adapted)

Market Variances

In addition to the above breakdown of the sales volume variance, the sales quantity variance can also be broken down as to why it occurred. The total level of sales may be different from expected because the market was bigger or smaller than expected, or because the company's share of the market was bigger or smaller than expected.

The **market size variance** is the difference in the budgeted contribution margin caused by the actual market size (in number of units) being different from the expected market size (in number of units). It is calculated as follows:

$$\left(\frac{(\text{Actual Market Size in Units} - \text{Expected Market Size in Units}) \times \text{Expected Market Share \%}}{\text{Market Share \%}} \right) \times \text{Standard Weighted Average Contribution Margin per Unit}$$

The **market share variance** is the difference in the budgeted contribution margin caused by the actual market share being different from the expected market share. It is calculated as follows:

$$\left(\frac{(\text{Actual Market Share} - \text{Expected Market Share})}{\times \text{Actual Market Size in Units}} \right) \times \text{Standard Weighted Average Contribution Margin per Unit}$$

Note: On the Exam, you only need to know that these formulas exist and what they are. It is unlikely that you will need to actually apply or calculate with these formulas.

Variance Analysis for a Service Company

A service company's "product" is the service it provides. An example of a pure service company is a public accounting firm. The public accounting firm has no cost of goods sold because its sole product is the service it provides. Some other service companies may offer a mixture of sales and service, for example if they sell repair parts and install them. An example of a combination sales and service organization is an appliance repair business.

Service companies can have price variances, volume (quantity) variances, mix variances related to the services they provide, and overhead variances. If a service company provides service only, then it can calculate price, quantity and mix variances for the revenue line. If the company not only provides service but also provides a product such as replacement parts, the company should segregate its service revenue from its parts revenue in its accounting system. It can then analyze its service revenue for the revenue line only while analyzing the parts sales variances the same way a reseller would analyze its sales variances: revenue, variable costs, and contribution margin.

Variance analysis can also be done by any company on its selling, and general and administrative overhead costs. Variable overhead can be a large component of a service company's costs, and it needs to be used in making pricing and service mix decisions.

A service organization may have very high fixed overhead costs. If revenue declines, the fixed overhead costs remain, and the company can very quickly find itself in financial trouble. Fixed overhead variance reporting can detect this early and may enable the company to make changes in its fixed cost structure to respond to the decreased sales.

Furthermore, a company that manufactures a product or resells a product will have both fixed and variable overhead costs for its non-manufacturing functions within the company, such as distribution. These costs also need to be included in pricing and product mix decisions, and variance analysis provides a way of doing that.

Responsibility Centers and Reporting Segments

A responsibility center is any part, segment or subunit of an organization. A segment may be a product line, a geographical area or any other meaningful unit. **Responsibility accounting** is an accounting system that measures accounting results of each responsibility center separately. It is also used to measure consolidated results.

A responsibility center's plans are expressed in its budget, and the actual results for that responsibility center are then compared against its budget to determine how well it is achieving its plans.

The budget is developed by responsibility center. All of the responsibility centers combined make up the consolidated budget. For instance, the Sales Budget is developed for each individual responsibility center, and all the responsibility centers' budgets together make up the consolidated Sales Budget. Consolidating all the different budgets for all the different responsibility centers is part of the process of developing the Master Budget.

The main purposes for responsibility centers and responsibility accounting are to enable evaluation of subunits' performance and contribute to measuring the performance of the subunits' managers. This provides motivation for managers of the subunits. By knowing what they are responsible for and controlling those items, managers should be more motivated than if they were evaluated on something outside of their control.

The main classifications of centers (listed in the order of most fundamental, or basic, to the least fundamental) are:

- 1) **Cost Center** – This type of center is **responsible only for the incurrence of costs**. A cost center does not have any revenue, and therefore has no profit. An example of this type of center would be an equipment maintenance department or an internal accounting department.

A cost center is the **least complex type of center** due to its being responsible only for costs, and the managers of a cost center are best evaluated by using variance analysis for these costs. The **efficiency of operations** is the key to the evaluation.

Note: A **service department** within a larger company is usually a cost center because it provides services to other departments, so it does not have any revenue.

- 2) **Revenue Center** – This type of center is the opposite of a cost center in that it is responsible only for revenues. A sales department is a revenue center. Though every department will incur some costs, the costs incurred by a revenue center are generally immaterial and may not even be controllable by the center. A revenue center's costs may simply be allocated to them by the central company. Managers in revenue centers are evaluated by the level of revenue that the center generates. **Effectiveness** is the key for the evaluation.
- 3) **Profit Center** – this is a department responsible for both revenues and expenses. An example would be a department within a store, which would have both revenues and cost of goods sold. Because a profit center is responsible for both costs and revenues, a manager of a profit center will be evaluated on both costs and revenues. In a profit center, **both efficiency and effectiveness are assessed**, but priority is given to effectiveness. In fact, the profit can be treated as the goal to be achieved.
- 4) **Investment Center** – An investment center is responsible not only for profit (revenues and costs), but also for some amount of invested capital such as equipment and for providing a return on that capital. Because it is responsible for a return-on-investment, this type of department is the most like a regular and complete business by itself. However, it is still part of an even larger organization. An example of this type of center is a branch office. **Effectiveness** in achieving/exceeding predetermined criteria is the key evaluation.

In an investment center, the most important criterion for evaluation is the **return-on-investment** provided by the investment center.

Note: Given the nature of the measurement of an investment center (return-on-investment), it is actually preferable for a company to have **as many investment centers as possible**. This is because the goal of any business (and therefore any part of a business) should be return on invested capital.

A responsibility center — any of the four types — is effectively a **unit for performance evaluation**. That performance evaluation may be of the unit itself, or it may be a part of the performance evaluation of the unit's manager, or it may be both. The reason responsibility centers exist is to make it possible to evaluate the performance of the various segments of the business and the performance of the segments' managers. Management uses this information to make strategic decisions such as, "Should we expand that location?" or "Should we promote that manager?"

The choice of whether to evaluate a given responsibility center as a cost center, a revenue center, a profit center or an investment center can be a critical one. Although it may seem fairly clear-cut — i.e., if a department has only costs, it is a cost center — in reality it is not that clear-cut. Nearly any responsibility center can be evaluated as an investment center, because every responsibility center uses fixed assets. Can a new computer system have a return-on-investment? Absolutely! If it doesn't, why buy it?

Comparison of actual results against budgeted amounts by a responsibility center is important feedback. It lets the manager of the responsibility center and top management know how well the manager has followed his or her plan. This feedback involves the manager in examining past performance and learning to make better-informed decisions in the future. For that reason, **feedback and the reporting of actual results, as compared to a plan, are the main links between planning and control**. It is important for feedback to be available in a timely manner, both to the manager and to top management. If it is not timely, it loses its relevance. Therefore, budget reports should be available as rapidly as possible after the end of a reporting period.

Budgets established within the framework of a responsibility accounting system provide systematic feedback for managers if used properly. Reports of variances from the budget (i.e., differences between actual results and planned activity) should be used to direct attention to problems, and the emphasis should be on information, not blame. If variance reports are used properly, they can be helpful in evaluating a manager's performance, but they should not be considered as the full story.

Note: Feedback is the main link between planning and control.

A company must always make a distinction between the performance of a **manager** and the performance of the **business unit** that the manager manages. A company might assign one of its best managers to a unit that has been unprofitable in an effort to turn the unit around. It might take the manager some time to effect a change, and, in fact, that unit might never be very successful. But should the manager's performance be judged on the basis of that unit's performance?

When evaluating managers, a company should focus its evaluation **only on those factors that the manager can actually control**. If a manager is evaluated based on something that he or she is unable to control (either a cost or revenue), there is a risk of inequity. The performance evaluation of the manager should be the performance evaluation of **only** the manager. For example, information on the unit's performance should be **part of** the performance appraisal of the manager, but it should not be the **only** information considered.

Note: Because of the nature of the calculation of contribution (selling price minus variable costs), contribution margin is something that is under the control of the manager of a profit center, if that manager has the authority to set prices and make purchasing and other decisions.

If a responsibility accounting system with variance reporting is used as an evaluation tool, it should be structured so that costs that are not under the manager's control will be excluded or at least segregated from the controllable costs.

In a larger sense, responsibility accounting should actually focus on **information** and **knowledge** more than on control. A responsibility accounting system should be able to identify the person who can tell us the most about an item in question, whether or not that person has any control over the item. A manager of a fast food restaurant may be held accountable for reporting on the profits of the unit, even though he or she does not have control over either the cost of the food or the price it is sold for. Again, this is not for the purpose of fixing blame. Nor should decisions outside of the manager's control be part of the manager's performance evaluation. However, the manager is still held accountable for reporting on the results, because he or she is closest to what is going on and is therefore in the best position to explain the variances between actual and budgeted items.

When managers of responsibility centers are accountable for their units' financial results, there are several issues that come up with respect to the way those results are determined. One of those issues is the allocation of common costs.

Allocation of Common Costs

Common costs are those costs that are shared by two or more responsibility centers, for example, costs of service departments such as IT, human resources or accounting. The costs need to be allocated between or among the various responsibility centers that receive benefit from them.

The method of cost allocation used should be one that will:

- 1) Provide accurate departmental and product costs for use in making decisions and evaluating the efficiency of departments and the profitability of individual products;
- 2) Motivate managers to make their best effort to achieve the company's strategic objectives;
- 3) Provide an incentive for managers to make decisions that are consistent with the goals of top management;
- 4) Provide a **fair** evaluation of a manager's performance; and
- 5) To justify costs such as transfer prices or to compute reimbursement when a contract provides for cost reimbursement.

Additionally, the process of allocation reminds each department that it is part of a larger organization and as such, has a responsibility to the larger organization.

Because cost allocations can affect managers' performance evaluations, they can easily become an issue within management ranks. Therefore, it is important that the method of allocating common costs be carefully selected and judiciously used.

Cost allocation can be done based on various systems:

- 1) **Cause and Effect.** Activities that cause resources to be consumed are identified, and cost allocations are based on each responsibility center's usage of the resources. For example, costs of a centralized call center could be assigned to products according to time spent by call center employees supporting customers of each product.
- 2) **Benefits Received.** Costs are allocated to the responsibility center or centers that benefit from the expenditure. For example, the costs of a marketing program for a particular product could be allocated to that product; or the costs of a public relations program that benefited the organization as a whole but no specific product could be allocated according to the revenues of each department or division.
- 3) **Fairness or Equity.** This is often a requirement for government contracts when a price to the government is based on costs and cost allocations. Cost allocation should be "reasonable" and "fair" and is more a matter of judgment than anything else.
- 4) **Ability to Bear.** Costs are allocated proportionally, according to individual responsibility centers' ability to bear the costs. For example, administrative salaries might be allocated on the basis of each responsibility center's operating income, on the assumption that more profitable divisions have a greater ability to absorb headquarters costs.

Cause and effect and benefits received are the better choices, because they provide better information for economic decisions and they also provide better motivation for both managers and employees.

Cause and effect is the basis of activity-based costing. Cost allocation based on cause and effect will provide an incentive for the managers to reduce their use of the service. On the other hand, if management **wants** the responsibility centers to make use of a service such as maintenance in order to improve the condition of their equipment, it might be better not to charge the responsibility centers with maintenance at all or else to subsidize it.

Allocation of central costs based on revenue or operating income leads to a system in which the biggest departments are charged the most for central services. Though this seems reasonable on the surface, it in fact may not be. It is possible that the biggest department is so large that it performs some of the central services itself. In this case, even though it is the biggest, it is not the largest user of the central services. And a unit that exceeds sales or profitability targets will absorb more of the common costs. The manager of that unit could see this as a "punishment" for exceeding the target.

Fairness and ability to bear are used less frequently and cause more problems than cause and effect and benefits received. It is difficult to obtain agreement on what is fair. What one responsibility center manager would consider fair, another responsibility center manager would regard as unfair. And where government contracts are concerned, it is particularly problematic. The government might consider the allocation of administrative costs to a contract as unfair, because the administrative costs would have been incurred without the contract. So even though fairness might be cited in a government contract as a means of cost allocation to the contract, it may be difficult to implement.

Ability to bear causes problems because an individual product might consume a large amount of indirect costs, but its selling price might be low for one reason or another, and because of that, the product is not profitable. Because it is not profitable, that product does not have the ability to bear the cost of the services it uses. If that product's costs are allocated to other products, the other products end up subsidizing the unprofitable product.

A company must make certain that all of the central costs are allocated to the production departments, regardless of what method it uses to allocate common costs. If all of the central costs are not allocated to the production departments, the company runs the risk of having each department covering its own costs, but the company as a whole not covering all of its costs.

However, a company must consider the costs versus the benefits when doing cost allocations. Costs include not only the research necessary to do the cost allocations but also the time required to educate the managers about the cost allocations. The more complex the cost allocations, the higher will be the costs to educate.

An alternative method is to allocate some percentage of each department's contribution to the covering of common costs, rather than allocating common costs to each department. This will hopefully enable managers of all the departments to see themselves as contributing to the overall success of the company rather than paying for a central administration that they do not perceive as adding value to their operations. Again, the company needs to make certain that all central costs are covered. If the individual departments do not meet their necessary targets, the company runs the risk of not collecting enough from the departments to pay for their central costs.

This method of allocation of central costs also plays a role in the evaluation process. As stated earlier, it is essential to evaluate a manager only on things that he or she can control. This includes central costs. If the manager cannot control the amount of central costs allocated to the department, then this cost should not be included in the evaluation of the manager.

Common costs are allocated in two ways: as **stand-alone costs** or as **incremental costs**.

- 1) The **stand-alone cost allocation method** allocates costs proportionately among all users on some basis that relates to each user's proportion of the entire organization. This could be based on each responsibility center's other costs as a proportion of the company's total costs; or it could be the proportion of each responsibility center's sales in relation to total sales of the entire company. The cost allocation methods discussed in Section A of this text are all stand-alone cost allocation methods.

Advocates of the stand-alone method say it is the fairest way, because each responsibility center bears a proportionate share of total costs.

- 2) The **incremental cost-allocation method** ranks users of a cost object according to their total usage or on some other basis. The first-ranked user of the activity is called the **primary** user. The primary user is charged for costs up to what its cost would be if it were the only user. Then, the next-ranked user(s) are called the **incremental** users and are allocated the additional cost, proportionately if more than one.

An advantage of this method is that if a user of a common cost is a newly formed sales office, its chances for survival may be greater if it is considered an incremental user and thus bears a relatively low allocation of common costs. Of course, all the users in an incremental cost allocation system will want to be the incremental users and not the primary user. And if there is really no basis for designating one user as the primary user and others as incremental users, the incremental method is not justified and can cause hard feelings.

Question 76: The receipt of raw materials used in the manufacture of products and the shipping of finished goods to customers are under the control of the warehouse supervisor. Approximately 60% of the warehouse supervisor's time is spent on receiving activities and 40% on shipping activities. Separate employees handle the receiving and shipping operations. The labor-related costs for the warehousing function are as follows:

Warehouse supervisor's salary	\$ 40,000
Receiving clerks' wages	75,000
Shipping clerks' wages	55,000
Employee benefit costs (30% of wage and salary costs)	<u>51,000</u>
	<u>\$221,000</u>

The company employs a responsibility accounting system for performance reporting purposes. The costs are classified on the report as period or product costs. The total labor-related costs to list on the responsibility accounting performance report as product costs under the control of the warehouse supervisor for the warehousing function are:

- a) \$97,500
- b) \$128,700
- c) \$130,000
- d) \$169,000

(CIA Adapted)

Question 77: A segment of an organization is referred to as a service center if it has:

- a) Responsibility for combining the raw materials, direct labor and other factors of production into a final output.
- b) Responsibility for developing markets and selling the output of the organization.
- c) Authority to make decisions affecting the major determinants of profit including the power to choose its markets and sources of supply.
- d) Authority to provide specialized support to other units within the organization.

(CMA Adapted)

Question 78: In a responsibility accounting system, managers are accountable for:

- a) Incremental costs.
- b) Product costs but not for period costs.
- c) Costs over which they have significant influence.
- d) Variable costs but not for fixed costs.

(CIA Adapted)

The Contribution Income Statement Approach to Evaluation

A variation of the contribution income statement can be used to isolate controllable costs of a business unit from its noncontrollable costs, such as depreciation or allocated central costs. Thus, it is a way of evaluating managers of profit and investment centers.

Example: Here is a contribution income statement prepared for the company as a whole and then broken down by division:

	<u>Company as a whole</u>	<u>Division 1</u>	<u>Division 2</u>
Net Revenues	\$10,000	\$3,000	\$7,000
<i>Variable Manufacturing Costs</i>	<u>3,900</u>	<u>900</u>	<u>3,000</u>
Manufacturing Contribution Margin	6,100	2,100	4,000
<i>Variable Nonmanufacturing Costs (selling, admin.)</i>	<u>600</u>	<u>100</u>	<u>500</u>
Contribution Margin	5,500	2,000	3,500
<i>Controllable Fixed Costs</i>	<u>1,250</u>	<u>500</u>	<u>750</u>
Controllable Margin or Short-term Segment Manager Performance	4,250	1,500	2,750
<i>Noncontrollable, Traceable Fixed Costs</i>	<u>2,000</u>	<u>600</u>	<u>1,400</u>
Contribution by Strategic Business Unit or Segment Performance	2,250	<u>\$ 900</u>	<u>\$1,350</u>
<i>Untraceable, Common Costs</i>	<u>1,000</u>		
Operating Income	<u>\$1,250</u>		

Below we look at each of the individual elements of the above income statement in more detail.

Net revenues represent the sales value of all sales for the period.

Variable manufacturing costs include all of the variable costs of production – labor, materials and variable overheads – that were incurred in the production of the **units sold**.

The **manufacturing contribution margin** of the company is the amount of money that is available to cover nonmanufacturing variable costs, all fixed costs and then flow to profit. After all variable manufacturing costs are covered, increases to the contribution margin flow directly to profit.

Variable nonmanufacturing costs include all variable costs that are not part of the production process. This includes, but is not limited to, marketing, selling, general and administrative costs that are variable in nature.

The **contribution margin** of the company is the amount of money that is available to cover fixed costs and then flow to profit, after all variable costs are covered.

Controllable fixed costs are fixed costs that the segment manager is able to control and influence. Examples of controllable fixed costs are supervisory salaries and any expenses that are incurred by that segment only such as some sort of sales promotion.

The **controllable margin** or **short-term segment manager performance** is important because it is a measurement of all the revenues and expenses (variable and fixed) that are controllable by the individual managers on a short-term (less than one year) basis. The controllable margin is a good measure of a manager's short-term performance.

Noncontrollable, traceable fixed costs are fixed costs that cannot be controlled by the manager within a time span of one year or less. They are usually facilities costs such as depreciation, taxes and insurance.

The **contribution by strategic business unit (SBU)** or **segment margin** is a measure of the performance of each business unit. It may also be used as a measure of the **long-term** performance of the manager, if the manager can control the noncontrollable traceable fixed costs over a long-term period. However, in many cases, decisions about noncontrollable traceable fixed costs are made by others.

For purposes of evaluating a segment or a manager, **noncontrollable, untraceable costs** must not be allocated to the individual segments. These are the costs that are incurred at the company level and would continue even if the individual segment were discontinued. These costs are important, and the overall company needs to be able to cover them. But they should not be a part of a segment manager's performance evaluation, because the segment manager has no control over them. For purposes of evaluation, they can be omitted from the individual segment reports. This will cause the individual segment reports to not total to the company's net income. In the example above, the sum of the two divisions' contributions is \$2,250, but the company's net income is \$1,250; the difference is untraceable, common costs.

Use of the Contribution Income Statement

A contribution income statement such as the one above is very flexible. It can be used to measure a manager's performance. It can also be used to measure the performance of a profit or investment center to determine whether the segment should be dropped, retained or expanded. The contribution income statement analysis can be extended to the product level, with each division's total revenues and expenses assigned to the various products produced by that division; this determines which products are contributing to the overall untraceable costs and which are not.

As you will note in the above calculations, **segment margin** is equal to sales minus all variable and fixed costs of the department. The other items that we calculated prior to the calculation of the segment margin are simply breaking down the different expense classifications. The only costs that are not included under each division are those common costs that are allocated to this department.

Note: For the Exam, you need to know how to calculate all of these different margins that are included in the contribution statement above.

A **profit margin ratio** is a measure of the amount of sales that actually become profits. It is the net income (or profit) amount divided by revenue (or sales).

In order to increase the profit margin a manager must either:

- 1) **Increase sales** while holding costs constant, or
- 2) **Decrease costs** without losing sales, or
- 3) **Increase sales at a rate greater than the increase in costs.**

Question 79: When using a contribution margin format for internal reporting purposes, the major distinction between segment manager performance and segment performance is:

- a) Unallocated fixed costs.
- b) Direct variable costs of producing the product.
- c) Direct fixed costs controllable by the segment manager.
- d) Direct fixed costs controllable by others.

(CMA Adapted)

Question 80: Consider the following information for Richardson Co. for the prior year:

- The company produced 1,000 units and sold 900, both as budgeted.
- There were no beginning or ending work-in-process inventories and no beginning finished goods inventory.
- Budgeted and actual fixed costs were equal, all variable manufacturing costs were affected by production volume only, and all selling variable costs were affected by sales volume only.
- Budgeted per unit revenues and costs were as follows:

Sales price	\$100
Direct materials	30
Direct labor	20
Other variable manufacturing costs	10
Fixed manufacturing costs	5
Variable selling costs	12
Fixed selling costs (\$3,600 total)	4
Fixed administrative costs (\$1,800 total)	2

The contribution margin earned by Richardson for the prior year was:

- a) \$25,200
- b) \$28,000
- c) \$31,500
- d) \$35,000

(CMA Adapted)

Transfer Pricing

A transfer price is the price that is charged by one unit of the company to another unit of the same company for the services or goods produced by the first unit and “sold” to the second unit. They are used by **profit and investment centers** in order to calculate the costs of services received from service departments and revenues when “selling” a product to another department when that product has an outside market. Transfer pricing is most common in firms that are vertically integrated, i.e., they are engaged in several different value-creating operations for a product. When transfers of goods or services are made from one profit center to another profit center within the same company, a portion of the revenue of one of the divisions is a portion of the cost of the other division. Therefore, the price at which the transfer takes place affects the earnings reported by each division. If the transfer price used is not the market price, this can distort reported profits and cause them to be a poor guide for cost center performance evaluation.

Note: A cost center works on pure cost basis and generally is passing along the costs of its service and is not looking to make a profit.

The basic issue of transfer prices is simply how much should one unit of a company charge another unit of the same company for its goods or services. The goal in setting a transfer price is that the method used will motivate the department managers to do what will provide the greatest benefit to the company as a whole, rather than to act in their own interest. In order to accomplish this, there must be goal congruence among the various departments, and management of the company needs to be committed to achieving those company goals. The transfer prices used should provide an incentive for managers to make decisions that are consistent with the firm’s goals, while at the same time, fairly rewarding the managers.

Transfer Pricing Objectives

For a multinational company with subsidiaries in several different countries, there are several considerations in setting transfer prices. For instance, transfer prices can be used to **minimize taxes**. If goods are shipped to a country with a relatively high tax rate from a country with a lower tax rate, it will benefit the company as a whole to set the transfer price high.

Multinational corporations are limited in their transfer pricing policies by host countries which restrict their actions when their intent is to avoid taxes. Transactions between subsidiaries of multinational corporations are supposed to be priced as “arm’s-length” transactions. In other words, the prices should be the same as they would be if the two parties were not related and should not be adjusted simply to shift the tax burden. U.S. laws regarding this are quite strict. However, some possibilities exist for flexibility in transfer pricing policies, and multinational corporations attempt to set transfer prices that reduce the tax burden while remaining within the legal guidelines. Examples of these possibilities to minimize taxes include charging administrative fees, royalties, and service fees. Each of these alternatives are still, of course, subject to the same principles of “arms-length” relationships and must be based upon actual business activity.

While these fees may be charged merely to shift earnings and thus minimize taxes, they have the side effect of distorting actual performance of the individual subsidiaries. Thus, the multinational corporation will need to account for this distortion when assessing the performance of each of its subsidiaries.

Another goal in setting transfer prices is **minimizing customs charges**. The transfer price set can affect the customs charges for goods imported from a foreign unit. If this is the case, a low transfer price would reduce the amount of customs charges levied on the shipment.

Repatriation of profits to the parent firm and **risk of expropriation** are two other considerations. Some countries place limits on the amount of profits that a foreign subsidiary may remit back to the parent company (repatriate). One way to deal with this is to use a high transfer price on goods being shipped to the foreign subsidiary from the parent, thus keeping the subsidiary’s profits low while claiming some of them in the higher transfer price. This is something a firm would also want to do if its management perceives a significant risk of expropriation, the risk that the foreign country will take ownership of the subsidiary away

from the parent. The parent company would set the transfer price for goods shipped to the subsidiary high in order to remove funds from the foreign country as quickly as possible.

Even a domestic company can use transfer prices to achieve objectives. If a company has warehouses in several states and some states levy a property tax on inventories while others do not, the company may keep transfer prices low on goods brought into the states with the inventory tax, in order to reduce its tax bill.

Since multiple management objectives are involved in setting transfer prices, it can be extremely difficult to establish sound intracompany transfer prices. Any transfer pricing system must accomplish the following:

- 1) It must give senior management the information it needs to evaluate the performance of the profit centers.
- 2) It must motivate the profit center managers to pursue their own profit goals while also working toward the success of the company as a whole.
- 3) It must encourage the cost center managers' efficiency while maintaining their autonomy^j as managers of profit centers.
- 4) It must be equitable, permitting each unit of a company to earn a fair profit for the functions it performs.
- 5) It must meet legal and external reporting requirements.
- 6) And it should be easy to apply.

Transfer Pricing Methods

There are a number of different ways that a company may choose as the basis to calculate the transfer price of a product or service. Generally, the decision of which method to use is made by **top management** and should take into account the goals of the entire company, while at the same time maintaining motivation of the departments. The more common methods are:

Market Price

The transfer price is set as the current price of the selling division's product in an arms-length transaction. When there is an external market for the product, this is almost always the **best transfer price** to use for profitability and performance measurement, because it is objective. It satisfies the "arm's length" requirement by taxing authorities. Furthermore, it satisfies the management of the buying company that they are paying a fair price for the goods and the management of the selling company that they are receiving a fair price for the goods. However, sometimes there is no external market and thus a market price is not available. Another drawback is that each transfer of product entails an element of profit and loss. It may be difficult to determine the actual cost of the final product. Furthermore, intracompany profit must be eliminated from inventories when consolidated financial statements and the income tax return are prepared.

Cost of Production plus Opportunity Cost

This is a calculation that includes not only the cost of production (called outlay cost), but also the profit margin that the selling department is giving up by selling the product internally rather than externally. Though this approximates a market price, it is not exactly a market price because a true market price may only be set in an arm's length transaction, which this is not.

^j "Autonomy" refers to a manager's freedom to make decisions. The greater the manager's freedom is to make decisions, the greater is the manager's autonomy.

Variable Cost

The Variable Cost method uses the selling division's variable costs only. This works well if the selling division has excess capacity and when the main objective of the transfer price is simply to satisfy the internal demand for goods. It is not appropriate if the seller is a profit or investment unit, though, because it will decrease the seller's profitability. Therefore, when the selling division does not have excess capacity, the selling division will prefer to sell to an outside customer. However, a transfer price equal to variable cost does encourage the buying division to buy the item internally.

Full Cost

Full cost includes all materials, labor and a full allocation of overhead. It is the full cost of production and is calculated using absorption costing. The advantages of using full cost are that it is well understood, and the cost information is easily available in the accounting records. Because the product is transferred at cost, there is no need to eliminate intracompany profits from inventories in consolidated financial statements and income tax returns. Furthermore, the transferred cost can be easily used to compare actual and budgeted costs.

However, because it includes fixed costs, full cost can be misleading and cause poor decision-making. It is not appropriate for decentralized companies that need to measure the profitability and performance of different profit centers. If full cost is used, the transfer price may well be higher than the buying department can get the item for by purchasing it outside. The buying department will prefer to go outside. However, the external price may be greater than the selling department's variable cost for the item. Since the fixed cost will be the same whether the part is manufactured internally or purchased outside, the consolidated profit of the firm will be lower if the purchasing department buys the item outside.

Cost Plus

Under this method we add some fixed dollar amount or a percentage of costs to the cost of production to approximate a normal profit markup. It can be used when a market price is not available.

This method may use either standard costs or actual costs. If **standard costs** are used, then there will be an opportunity to separate out variances. If **actual costs** are used, then there is no motivation for the manager of the producing and selling department to control the department's costs, because whatever costs are incurred will be passed on to the next department. And if the profit markup is a percentage of cost, it actually gives the selling department an incentive to inflate the cost through production inefficiencies and excessive allocation of common costs.

Note: Cost plus is what is generally used in government contracts in the US and a commission was set up by the government to help determine what the cost of production is and what can be included in this calculation.

Negotiated Price

In order for this method to work, each department or unit must have the ability to determine the amount of its materials that it buys or the amount of its output that it sells. This method is going to be the most useful when the products in a market are rapidly changing and the companies need to be able to react quickly to changes in the market place. It also can be helpful if the units are having a conflict and negotiation can bring about a resolution. However, in order to be effective, neither negotiating party should have an unfair bargaining position. A drawback of this method is that negotiation can be time-consuming and require frequent revision of prices because of changing costs and market conditions. Time required for negotiating diverts the attention of division managers away from more productive activities that would benefit the company, to activities that benefit the division. And the resulting division profits may be more a measurement of the manager's negotiating ability than the division's productive efficiency.

Note: Theoretically a market price is the best method for determining a transfer price as it will essentially make all internal departments the same as an external department.

Arbitrary Pricing

Transfer prices may simply be set by central management to achieve tax minimization or some other overall objective. The advantage to this method is that the price achieves the objectives that central management considers most important. The disadvantages far outweigh the advantages, however, because this method defeats the goal of making divisional managers profit conscious. It hampers their autonomy as well as their profit incentive.

When deciding which method to use, management will generally consider a number of factors. The most common factors are the following items:

- The **goals of the company** and what method will best enable those goals to be met (goal congruence), and
- Factors relating to the **capacity of the producing department**, its ability to sell the product on the open market and the ability of the purchasing department to buy the product on an open market.

Ultimately, the selling department should be able to recover costs and opportunity cost and the purchasing department should not be required to pay more than it would on the open market.

This usually means that the transfer should be done at the market price, as only this will be able to satisfy the second item listed above. However, in some situations there may be a price below the market price that would still be beneficial to the firm as a whole. This will happen in a situation in which the selling department is not producing at its maximum capacity.

If the seller department has **excess capacity**, it makes sense to transfer the goods at a price that is only \$1 greater than the variable cost of production. If this is done, the selling department will have a greater contribution than it would otherwise, and the purchasing department will have a lower cost of production because of the internal transfer.

Note: Different state and national tax rates will also impact how a company will determine transfer prices. The goal of the company is to increase its overall profit by reducing tax liabilities. Using a transfer price that would not be used otherwise may minimize the company tax liability. If this is done, it is important that the manager not be penalized because of the result of this artificial transfer price that is used to minimize taxes.

Similar issues may arise from exchange rates between currencies, currency laws in place in some countries, tariff laws in some countries or the availability of materials or labor in some countries. All of these may cause the company to choose a transfer price that does not on the surface seem to be the best.

Dual-Rate Pricing

Dual-rate pricing is a method in which the selling and the purchasing departments each record the transaction at different prices. For example, the seller records it at market value, but the purchasing department records it at the variable cost of production. As a result of this, each department's results are more positive on paper. If this is done, the total of the divisional profits will be greater than the profit for the company as a whole. The profit assigned to the producing division will need to be eliminated when the consolidated financial statements and income tax returns are prepared.

The **advantage** of this is that the selling division has an incentive to expand sales and production; while at the same time, the buying division gets to book the product at its actual cost to the firm. So the buying division's costs do not include an artificial profit for the selling division. Thus, variable cost is used for decision-making, but market price is used for evaluation.

The **main disadvantage** of this system is that it is complex and there is difficulty inherent in evaluating the relative performance of the selling and the buying divisions, because their profits have been determined on different bases.

Note: When we look at a decision to buy internally or externally from the perspective of the buying department, it will buy from the source that has the cheapest cost. However, if we look at this same problem from the company's standpoint, the company will look at it based upon the variable costs of production and the contribution standpoint for the internal supplier. The fixed costs of the internal supplier are a sunk cost and will not change no matter where the units are purchased. This means that even if the transfer price is higher than an outside supplier's price, the company as whole will be better off if the buying department buys internally if the variable costs of the internal supplier are lower than the price of the external supplier.

In this case, the buying department will be worse off because of buying internally, but the company as a whole will be better off than it would have been if the buying department had bought externally.

Example: Blitz Corporation has two divisions – A and B. Division B currently operates at 100% of its capacity and produces two products: widgets and gadgets. Division B sells both products to outside customers for \$15 and \$30 per unit, respectively. The variable costs for widgets are \$10 per unit, and fixed costs are \$3 per unit at the current production level. For gadgets, the variable costs are \$16 per unit, and fixed costs are \$8 at the current production level.

Division A, which currently purchases widgets from an outside supplier for \$16 per unit, would like to purchase 150 widgets from Division B annually. However, if Division B increases the production of widgets to meet the demand of Division A, it must stop producing gadgets entirely. Also, to meet stricter quality requirements of Division A, Division B must increase materials cost by \$0.80 per widget, but the marketing and transportation cost per widget will be reduced by \$0.50 per unit. The total number of units of gadgets produced and sold by Division B is 50 units per year.

What is the price range within which the transfer price for widgets would satisfy both divisions?

Solution:

The transfer price acceptable for both the seller and the buyer, and hence, the whole company, should be between:

The **variable costs of production (VC) plus opportunity cost (OC)** of forgone production for the seller (lost contribution margin) per unit, and

The **market price** of the product.

In a formula, it would look like this:

$$VC + OC \leq \text{Transfer Price} \leq \text{Market Price}$$

We now need to solve for the variable cost, opportunity cost and market price.

Variable cost for widgets produced by Division B for Division A is **\$10.30** per unit (\$10 + \$0.80 – \$0.50).

The contribution margin lost on each gadget is \$30 – \$16 = \$14. Therefore, the total contribution margin that is lost by Division B for the 50 gadgets that would not be produced if it sells widgets to Division A is \$700 (50 units × \$14 per unit). The **opportunity cost** that is given up with the production of each widget for Division A is **\$4.67** (\$700 ÷ 150 units).

Adding the variable costs per unit and the opportunity cost per unit together, we get the **minimum transfer price of \$14.97** (\$10.30 variable costs + \$4.67 opportunity cost).

The **market price for a widget is \$16**.

So, the optimal transfer price for all parties must be between \$14.97 and \$16. Any price lower than \$14.97 will not be acceptable for Division B, and any price higher than \$16 will not be optimal for the Division A because it could buy it cheaper on the open market.

Question 81: A limitation of transfer prices based on actual cost is that they

- a) Lack clarity and administrative convenience.
- b) Charge inefficiencies to the department that is transferring the goods.
- c) Must be adjusted by some markup.
- d) Can lead to suboptimal decisions for the company as a whole.

(CIA Adapted)

Question 82: Division Z of a company produces a component that it currently sells to outside customers for \$20 per unit. At its current level of production, which is 60% of capacity, Division Z's fixed cost of producing this component is \$5 per unit and its variable cost is \$12 per unit. Division Y of the same company would like to purchase this component from Division Z for \$10. Division Z has enough excess capacity to fill Division Y's requirements. The managers of both divisions are compensated based upon reported profits. Which of the following transfer prices will maximize total company profits and be most equitable to the managers of Division Y and Division Z?

- a) \$12 per unit.
- b) \$22 per unit.
- c) \$20 per unit.
- d) \$18 per unit.

(CIA Adapted)

Question 83: Division A of a company is currently operating at 50% capacity. It produces a single product and sells all its production to outside customers for \$13 per unit. Variable costs are \$7 per unit, and fixed costs are \$6 per unit at the current production level. Division B, which currently purchases this product from an outside supplier for \$12 per unit, would like to purchase the product from Division A. Division A will operate at 80% capacity to meet the demand of outside customers and Division B. What is the minimum price that Division A should charge Division B for this product?

- a) \$9.60 per unit.
- b) \$12.00 per unit.
- c) \$13.00 per unit.
- d) \$7.00 per unit.

(CIA Adapted)

Question 84: The alpha division of a company, which is operating at capacity, produces and sells 1,000 units of a certain electronic component in a perfectly competitive market. Revenue and cost data are as follows:

Sales	\$50,000
Variable costs	34,000
Fixed costs	12,000

The minimum transfer price that should be charged to the beta division of the same company for each component is:

- a) \$12
- b) \$50
- c) \$46
- d) \$34

(CIA Adapted)

Question 85: The Eastern division sells goods internally to the Western division of the same company. The quoted external price in industry publications from a supplier near Eastern is \$200 per ton plus transportation. It costs \$20 per ton to transport the goods to Western. Eastern's actual market cost per ton to buy the direct materials to make the transferred product is \$100. Actual per ton direct labor is \$50. Other actual costs of storage and handling are \$40. The company president selects a \$220 transfer price. This is an example of:

- a) Negotiated transfer pricing.
- b) Cost plus 20% transfer pricing.
- c) Cost-based transfer pricing.
- d) Market-based transfer pricing.

(CIA Adapted)

Performance Measures

Strategic Issues in Performance Measurement

Companies need to measure performance and reward outstanding performance in a way that motivates their managers to achieve the **company's** strategic objectives and operational goals. If the performance measurement system rewards managers for achieving only their own units' goals, it is quite possible that managers will maximize their own units' performance without necessarily maximizing the company's performance. Therefore, any performance evaluation measures used should be directly related to the company's strategic objectives and operational goals. Specific performance targets such as increasing market share in key customer segments or reducing costs or providing innovative products and services need to be reinforced by the management reward system, so that managers' rewards are dependent upon achieving the target performance.

In the section on Budgeting, we defined "goal congruence" as "aligning of goals of the individual managers with the goals of the organization as a whole." Goal congruence means that individuals and organization segments are all working toward achieving the organization's goals. It means that managers who are working in their own best interest are accomplishing that and at the same time are taking actions that accomplish the overall goals of the company's senior management. It is important to evaluate managers on their achievement of goals that benefit the **company**, not on goals that benefit their own department or division.

Another strategic issue in performance measurement is short-term versus long-term focus. Too much emphasis on this quarter's results will nearly always cause managers to eliminate or postpone activities that are vital for the firm's long-term success, such as R&D, in order to improve short-term profits. If the long-term focus is lost, the business's future success will be endangered. For example, a pharmaceutical company that cuts back on its new drug R&D to improve its current results will eventually find itself with patents on its existing drugs running out (thus exposing it to competition from generics) and no new drugs in the pipeline.

Timing of Feedback

An important part of any performance measurement system is the feedback it generates. The timing of the feedback is important, because feedback that is not received in a timely manner is not useful. The proper timing of the feedback depends on who the information is going to, how critical the information is, and what the information is.

For example, managers who are responsible for profit centers need information about their sales volumes quickly, on a daily or a weekly basis, particularly in a business with high fixed costs. When a manager is responsible for generating adequate sales to cover high fixed expenses, he or she needs to know immediately if sales decline so actions can be taken to reverse the decline. However, daily or weekly sales information would probably be too frequent for top management. Top management may need sales information only on a monthly basis, although if there is cause for concern, they may need the information more frequently.

Performance Measurement

In the topic of Responsibility Centers and Reporting Segments, we looked at the contribution income statement as a means of evaluating the performance of reporting segments and segment managers. The financial success of a segment and thus the performance of its manager can be measured in other ways besides the contribution income statement. Return on Investment (ROI) and Residual Income (RI) are the primary means of financial measurement that you need to know. You need to know what each one is, how each is calculated, how each one is interpreted, and how they compare with each other.

We will start by stating that each of these methods by itself measures only one thing and therefore, one by itself does not provide a complete evaluation of a manager or a department.

Note: In addition to these numerical and financial based measures, it is also critical that the evaluation process contain non-financial measures such as customer satisfaction, quality reports and employee turnover. Other measures that are specific to the business or individual job should also be included.

Return-on-Investment (ROI)

ROI is the key performance measure for an investment center. It provides the measure of the percentage of return that was provided on the dollar amount of the investment (i.e., assets). Several different measurements of investment are used.

When Total Assets will be used as the denominator, the calculation is:

$$\frac{\text{Net Income}^k \text{ of the Investment Center}}{\text{Average Total Assets (or Investment) of the Investment Center}}$$

"Average Total Assets" is calculated: (Beginning Total Assets + Ending Total Assets) ÷ 2

In using ROI, the company needs to decide what it will use as the **measure of total assets** (or investment). There are a number of different possibilities, as follows:

- **Working Capital (Current Assets – Current Liabilities) plus Fixed Assets** – This method includes only assets that are financed with long-term liabilities and equity; assets that are financed with current liabilities are not included in the calculation. We also call this **invested capital**.

Note: Unless otherwise instructed, use this method to calculate the investment base (the denominator of the ROI formula) in an Exam question.

- **Total Assets** – This is used when a manager is evaluated on his/her utilization of all assets, regardless of the method of financing of these assets. This measure may be used because of the assumption that all of the assets that are in the business unit (including **net working capital**) are really "on loan" from the parent company. Working capital is calculated as current assets minus current liabilities.
- **Long-term Assets** – This includes invested capital and property, plant and equipment (or fixed assets).
- **Total Assets Employed** – Idle assets such as vacant land or an idle machine are subtracted from the total assets.
- **Average Invested Capital** – It is calculated as the invested capital at the beginning of the year plus the invested capital at the end of the year divided by 2.

A variation on this method provides us with a measure of the **return on shareholders' equity (ROE)**. There is a problem, however, with using equity as the denominator for ROI analysis, because it reflects all of the company's liabilities, both current and long-term. This means that the **measurement basis for the evaluation is probably outside of the control of the manager**. This is because most managers of a department are not involved in the decisions about how to finance the investments that the larger company is making (i.e., short-term debt, long-term debt or equity).

The formula is:

$$\frac{\text{Net Income}}{\text{Average Shareholders' Equity}}$$

^k This net income figure may be before or after taxes. In some cases, it may also be operating income. It does not matter which is used as long as the same measure is used for all divisions or departments or projects being measured by ROI. Unless otherwise noted, use net income before tax on the Exam.

Since the focus of ROI is to measure the performance of managers in meeting the goals set by senior management, shareholders' equity is not generally used for this purpose.

Whatever specific formula is used in this calculation, if ROI is used as an evaluation tool, management must be certain that it is the correct measurement for the company's goals, and that the ROI goals are representative of that individual department's market and business.

A manager can use ROI to determine if the division should accept an investment or project. If the ROI of the project is higher than the target or required return, or hurdle rate, the manager will accept the project. Conversely, if the ROI is lower than the required rate of return, the manager will reject the project, even if the project itself is profitable.

However, the biggest problem with using ROI alone to evaluate managers is this: If the expected ROI of a new project under consideration is lower than the division's present ROI but higher than the target rate, the manager may reject a profitable project because it would lower the division's overall ROI, even though the project would be beneficial for the company. **The problem with ROI is that it measures return as a percentage rather than as a dollar amount.** While it is good to have a higher rate of return, the company is ultimately interested in the **amount** of the return, and any project with a return higher than the required rate of return will increase the company's net profit, even though it may reduce that division's ROI, if the division's current ROI is higher than the expected ROI of the new project. As a result of this shortcoming, ROI is often used together with other measurement tools.

Another disadvantage of using ROI for performance measurement is that when a manager is evaluated using current ROI, the pressure to meet the current period's ROI target may cause the goal of short-term profits to take precedence over efforts to improve long-term profits. In the long term, this can lead to **reduced** performance, such as when the manager reduces R&D spending, advertising, employee training or productivity improvements in order to make current ROI look better.

Measuring *Income* and *Investment* for ROI

ROI can be used to evaluate not only the performance of the entire firm, but it can be used to evaluate the performance of individual division managers. When ROI is used to evaluate individual division managers, and even when it is used to evaluate the whole firm, it is important to recognize how accounting policies affecting the methods used to measure income and investment can affect ROI.

The accounting policies that have the most effect on ROI relate to revenue and expense recognition and asset measurement, and five of them are particularly important. Any differences among divisions in how revenues, expenses and assets are accounted for can significantly influence interpretation of the divisions' ROIs and their comparability.

Inventory

All of the divisions need to be using the same inventory cost flow assumption (i.e., FIFO, Weighted Average, or LIFO). The choice will affect both net income and total assets.

- Under FIFO, the assumption is that the inventory acquired **first** is the inventory that is sold. Therefore, inventory on hand consists of the most recently purchased units. In a period of rising prices, inventory will be higher under FIFO than under any of the other cost flow assumptions. In addition, Cost of Goods sold will be lower, so net income will be higher. This usually results in higher ROI.
- Under LIFO, the assumption is that the inventory acquired **last** is the inventory that is sold. Inventory on hand consists of the oldest units purchased, so inventory under LIFO will be lower than under any of the other cost flow assumptions (assuming prices are rising) and total assets will also be lower. Net income will be lower as well. This usually results in lower ROI.
- Inventory and net income under Weighted Average Cost will be in between FIFO and LIFO, and so will ROI.

Example of ROI under the three inventory cost flow assumptions in a period of rising prices with all other variables held constant:

	Weighted <u>Average Cost</u>	<u>FIFO</u>	<u>LIFO</u>
Average Inventory	\$ 1,000,000	\$ 1,500,000	\$ 500,000
Average Other Assets	5,000,000	5,000,000	5,000,000
Average Total Assets	6,000,000	6,500,000	5,500,000
Net Income	1,100,000	1,600,000	600,000
ROI	.18	.25	.11

Depreciation

The divisions need to be using the same method to depreciate fixed assets, and the methods used in measurement need to be fair for all of the divisions. Even though the same depreciation method may be being used for all of the divisions, the results may still not be comparable or fair.

- Older fixed assets will have a lower book value than newer fixed assets because more depreciation has been recognized. Therefore, if book value of fixed assets is used in Total Assets, the same dollar amount of income in two divisions will produce a higher ROI in the division with the older assets. Because the assets are older and their book value is lower, the denominator will be lower and the ROI will be higher.
- Furthermore, depreciation expense on the older assets will be lower. If an accelerated method of depreciation is being used, more depreciation expense is recognized in the early years of the assets' lives, so income will be higher in the later years of the assets' lives. And older assets may be fully depreciated, so no depreciation expense at all will be recognized on those assets.
- For a division with older assets, a higher income combined with lower fixed asset values together can create an unrealistically high ROI and the profitability of the division with older assets may appear to be higher than it actually is. When the assets are replaced, as they must be, the current replacement value will be much higher and the ROI much decreased. The division's net income may not be adequate to support the replacement of the assets at their current higher value.

This problem can be alleviated by using **current market value or replacement value of the assets** rather than historical or net book value. In this way, a future profitability problem can be revealed, enabling timely corrective action. Use of current asset values will make the ROI more relevant and comparability of divisions will be restored.

Capitalization Policy

Companies have policies that state when an item is to be expensed and when it is to be capitalized as an asset. When a newly purchased asset is expensed, net income is reduced, resulting in reduced ROI; and the opposite is true when the asset is capitalized. The same policy needs to be in effect for all divisions of the company.

Use of Full Costing

The use of full costing will cause net income and thus ROI to rise when inventory levels rise and to fall when inventory levels fall.

Disposition of Variances

Firms also have policies about the way variances are to be handled. The variances may be closed to Cost of Goods Sold, or they may be prorated among Cost of Goods Sold and the Inventory accounts. The choice will affect both net income and inventory balances. If variances are closed to Cost of Goods sold only, net income and also inventory will be distorted, and ROI will in turn be distorted. The distortion could go either way.

However, if the variances are prorated, net income and inventory will not be distorted because they will be the same as they would have been had there been no variances.

To maintain comparability among divisions, all divisions must use the same accounting policies in these five areas. Furthermore, top management should consider whether the accounting policies in use, even if standardized among divisions, may be causing income to be under- or overstated and/or investment to be under- or overstated throughout the organization.

Other Income Measurement Issues

Other things can affect the measurement of income and thus, the measurement of ROI, reducing comparability among business units.

- **Nonrecurring Items** – Nonrecurring charges or revenues can cause net income of a given business unit to be not comparable to that of prior periods and not comparable to net income of other business units.
- **Income taxes** – Income taxes may affect different units differently, especially if the units are located in different countries with different tax rates and varying tax treaties. Even within the U.S., state income and franchise tax rates vary from state to state.
- **Foreign exchange** – Income and value of investments in foreign countries can fluctuate due to fluctuations in currency exchange rates.
- **Joint asset sharing** – Allocations of costs for common facilities or services need to be allocated on a fair basis, as discussed in the topic of **Allocation of Common Costs**. Different methods of allocating the common costs will result in different costs for each unit and thus will affect the units' income.

Which Assets to Include in *Investment* and How to Value Them

We have already said that the primary method for defining investment for the purpose of calculating ROI is to use working capital plus net fixed assets. However, what specific assets should be included?

- Investment is commonly defined as the net cost of long-lived assets plus net working capital (total current assets minus total current liabilities). However, only assets actually controlled by a unit should be included in its investment for the purposes of calculating its ROI.
- If current assets on the books of a division are actually controlled at a higher level in the company, they should not be included in the calculation of that division's investment. This includes cash, receivables and inventory. Only the cash, receivables and inventory that are controlled by the division should be included.
- Fixed assets should be included in a division's investment only if they can be traced to that division. Problems arise when assets are leased or idle or if they are shared with another division.
 - Leased assets should generally be included in investment, because they are assets being used to generate income. The company should have a policy about how leases are treated in calculating ROI, so that managers will either lease or not lease, according to policy.
 - If idle assets can be used for something else or can be sold, they should generally be included in the division's investment amount for calculating ROI. However, this policy can be used to encourage managers to either sell idle assets or hold them. Including them in investment will motivate the manager to sell the idle assets in order to reduce investment and increase the ROI, so if top management wants managers to sell idle assets, they should include them in investment. On the other hand, if top management believe holding the idle assets would be advantageous for some reason, excluding them from investment for ROI will motivate managers to hold them, since holding them will not reduce their ROI.

- If facilities are shared by two or more divisions, management must work out a fair sharing arrangement. Assets that cannot be traced to one particular division need to be allocated on a basis that reflects actual usage by each division as much as possible. Some shared facilities need to be quite large in order to accommodate periods of high demand. In that circumstance, the assets should be allocated based on the peak demand by each division rather than on total usage.

The value of investment is typically the historical cost of the assets. For current assets, the historical cost is their book value. For fixed assets, the historical cost is the net book value, i.e., their historical cost less accumulated depreciation. However, the use of net book value for long-lived assets can create a problem if the long-lived assets make up a major portion of a unit's total investment.

Price changes since the purchase of the assets can cause their historical costs figures and net book values to be at best irrelevant and at worst misleading. The relatively small historical cost of the assets can cause ROI to be significantly overstated when compared with what ROI would be if it were calculated using the current value of the fixed assets. The inflated ROI can create an illusion of profits that will not be there when the assets are replaced in the future at their current value at that time. The amount of income the business unit is generating may not be adequate to support the assets' replacement.

- 1) Use of current value makes it possible for the company to identify low profitability in a timely manner, whereas use of historical value can delay this recognition.
- 2) The use of current value for the assets of all the business units reduces the unfairness of using net book value when the various business units have assets of different ages. When net book value is used, units with older assets will have higher ROIs than units with new assets, because the net book values of the older assets will be significantly lower than the net book values of the newer assets. If the older and the newer assets are providing equivalent service, this will be unfair to the manager of the unit with newer assets.

The use of current value for long-lived assets is preferred for the calculation of ROI because the use of current values improves ROI as a measure both of the economic performance of the units and of the managers' performance.

Measures that may be used for current values include: (1) gross book value not reduced by accumulated depreciation; (2) replacement cost; and (3) liquidation value. All of the measures have their place, depending upon the purpose of the ROI calculation.

- **Gross book value** is the historical cost of the existing assets. The advantage of using gross book value is that it eliminates the problem of different ages of assets among business units. However, it does not reflect price increases that may have taken place since the assets were purchased. Gross book value is preferred by managers who want to use a verifiable, objective number.
- **Replacement cost** is the current cost to replace the assets at their current functionality. Replacement cost would be preferable if ROI is being used to evaluate managers and units as on-going enterprises, because it represents what it will cost to replace the assets they are currently using.
- **Liquidation value** is what the assets would bring in a liquidation of the business. It does not represent the value of the units as on-going enterprises, because of the assumption that the business would be being liquidated. Liquidation value will almost always be lower than replacement value and historical cost. However, it is useful when management is using a business unit's ROI to evaluate whether to dispose of the unit. In that situation, the relevant current cost would be the assets' liquidation value.

A company may have a significant amount of **intangible assets** that are not recorded in the financial statements. Under U.S. GAAP, only intangible assets that have been purchased, such as patents, copyrights or goodwill resulting from an acquisition may be recorded as assets. Investments in R & D will not be on the balance sheet, because those must be expensed as they are incurred. Therefore, investment may be substantially undervalued on the financial statements and net income may be distorted by the high expense for R & D. This fact must be considered when evaluating a business unit's ROI.

Question 86: The following information pertains to Quest Co.'s Gold Division for the current year:

Sales	\$311,000
Variable costs	250,000
Traceable fixed costs	50,000
Average invested capital	40,000
Imputed interest rate	10%

Quest's return-on-investment was:

- a) 10.00%
- b) 13.33%
- c) 27.50%
- d) 30.00%

(CPA Adapted)

Question 87: Listed below is selected financial information for the Western Division of Hinzel Company for last year:

Average working capital	\$625,000
General and admin expenses	75,000
Net sales	4,000,000
Average plant and equipment	1,775,000
Cost of goods sold	3,525,000

If Hinzel treats the Western Division as an investment center for performance measurement purposes, what is the before tax ROI for last year?

- a) 34.78%
- b) 22.54%
- c) 19.79%
- d) 16.67%

(CMA Adapted)

Question 88: The selection of the denominator in the return-on-investment (ROI) formula is critical to the measure's effectiveness. Which denominator is criticized because it combines the effects of operating decisions made at one level of the organization with financing decisions made at another organizational level?

- a) Total assets employed.
- b) Working capital.
- c) Total assets available.
- d) Shareholders' equity.

(CMA Adapted)

Question 89: Return-on-investment (ROI) is a term often used to express income earned on capital invested in a business unit. A company's ROI will increase if:

- a) Sales increase by the same dollar amount as expenses and total assets increase.
- b) Sales remain the same and expenses are reduced by the same dollar amount that total assets increase.
- c) Sales decrease by the same dollar amount that expenses increase.
- d) Sales and expenses increase by the same percentage that total assets increase.

(CMA Adapted)

Residual Income (RI)

Residual Income (RI) attempts to overcome the weakness in ROI by measuring the **amount of return** that is provided by a department. RI for a division is calculated as the amount of return (**net income before taxes**) that is in excess of a targeted **amount of return** on the investments employed by that division. Residual income is the income earned after the division has covered the required charge for the funds it has invested in its operations.

Two items that you need to know in regard to the calculation of RI are:

- The **targeted amount of return** is usually some percentage of the total employed assets of the division or the **invested capital** in the division, and
- The **percentage used** in the calculation is the **target rate** that management has set.

If the target rate is not available in the question, you should use the company's **weighted average cost of capital** (which will be given in the question).

Note: Invested capital is usually calculated as fixed assets plus working capital. Capital assets or land that is idle should not be included in the amount of the investment.

When using this method to evaluate investment opportunities, any project that has a positive RI will be accepted even if it will reduce the overall company or division ROI.

The **formula for RI** is:

$$\begin{aligned} & \text{Net income before taxes on project or investment opportunity} \\ - & \text{Target return in dollars: a \% of employed assets or invested capital} \\ = & \text{Residual Income} \end{aligned}$$

Example: Paterno Company has Total Assets of \$4,000,000 and Net Operating Income of \$600,000. Its target, or required, rate of return is 10%. How much residual income does Paterno have?

The Target return = \$4,000,000 × .10 = \$400,000

Net Operating Income of \$600,000 less \$400,000 target return = \$200,000 of residual income.

In the calculation of Residual Income, the target rate of return multiplied by invested capital is considered an **imputed cost** of the investment. This imputed cost is the **opportunity cost** of other potential returns that have been forgone in order to make the investment.

Note: Residual Income may be a negative amount. This occurs when the profits that the division or project actually achieved are less than the target income that was set for the division or project.

Alternate Methods of Calculating Residual Income

Although gross assets employed are generally used in calculating Residual Income, a variation on the calculation adjusts net income to remove interest expense (i.e., by adding interest expense after tax) and adjusts the calculation of the target return by subtracting from total employed assets the current liabilities that do not incur interest.

In other words, the calculation is:

$$\text{Net Income} + [\text{Interest expense} \times (1 - t)]$$

- Target return in dollars: a % of (Employed assets – Non-interest bearing current liabilities)
- = **Residual Income**

Another alternate method of calculating Residual Income uses Operating Income instead of Net Income. Residual Income under this approach would be

$$\text{Operating income of division or other segment}$$

- Target return in dollars: a % of employed assets or invested capital
- = **Residual Income**

Use of operating income is consistent with the purpose of Residual Income, which is to evaluate individual operating units. However, in reality, Residual Income can be calculated in any way that management wants to see it, depending on what is meaningful to them.

If you get an exam question on Residual Income, be aware of the various ways in which RI can be calculated.

Advantages and Disadvantages of Using Residual Income

RI overcomes the weakness inherent in using ROI alone to evaluate managers. Its advantage is that it motivates them to maximize an absolute amount — dollars of Residual Income — instead of a percentage (ROI). The result of this is that as long as a project for a subunit will earn an amount in excess of the charge for the funds needed for the investment, that project will be accepted. Using RI as a performance measure instead of ROI overcomes the tendency of managers to reject projects that would be profitable to the company as a whole but that would lower the business unit's current ROI. This would happen when a project has an ROI that is lower than the unit's current ROI, but the project would still be beneficial to the company. Thus, using RI a project that would be good for the company is more likely to be selected, even if its ROI is lower than the unit's existing ROI.

Another advantage of RI is that a firm can adjust the required rates of return for differences in risk. A unit with higher business risk can thus be evaluated using a higher required rate of return than that used for a unit with lower business risk.

RI also enables a company to use a different investment charge for different classes of assets. For example, the company could use a higher required rate of return for long-lived assets especially if their resale value is expected to be low and a lower required rate of return for shorter-term assets such as inventory.

However, RI has a weakness in that it focuses on the dollar amount of the return that is provided. Although a \$1 return is beneficial to the company, the amount of the return may be so small in comparison with the amount invested that the return provided is not worth it. As such, RI is often used together with another evaluation measure.

Another disadvantage of using RI to compare performance of different subunits is that because RI is not a percentage, it is not very useful for comparing units of different sizes. A large subunit would have larger residual income than a small unit, whereas the smaller unit might be performing much better than the large unit, relative to its size. In addition, a small change in the required rate of return would have a greater effect in dollars on the RI of a large unit than it would on the RI of a small unit.

In addition, RI has the same issues as ROI with respect to distortion caused by the accounting policies selected by the company. Residual Income must be interpreted carefully because of the various effects of different accounting policies on net income and on the amount used for investment.

Question 90: Zack Corp. had the following information for 2003:

Sales	\$500,000
Operating income	50,000
Operating assets	200,000
Imputed interest rate	10%

What amount of residual income did Zack have?

- a) \$(20,000)
- b) \$5,000
- c) \$10,000
- d) \$30,000

(HOCK)

Question 91: The imputed interest rate used in the residual income approach to performance evaluation can best be described as the:

- a) Average lending rate for the year being evaluated.
- b) Historical weighted-average cost of capital for the company.
- c) Target return-on-investment set by the company's management.
- d) Average return-on-investments for the company over the last several years.

(CMA Adapted)

Question 92: REB Service Co. is a computer service center. For the month of May, REB had the following operating statistics:

Sales	\$450,000
Operating income	25,000
Net profit after taxes	8,000
Total assets	500,000
Shareholders' equity	200,000
Cost of capital	6%

Based on the above information, which one of the following statements is correct? REB has a:

- a) Return-on-investment of 4%.
- b) Residual income of \$(5,000).
- c) Return-on-investment of 1.6%.
- d) Residual income of \$(22,000).

(CMA Adapted)

Question 93: Residual income is a better measure for performance evaluation of an investment center manager than return-on-investment because:

- a) The problems associated with measuring the asset base are eliminated.
- b) Desirable investment decisions will not be neglected by high-return divisions.
- c) Only the gross book value of assets needs to be calculated.
- d) The arguments about the implicit cost of interest are eliminated.

(CMA Adapted)

Weighted Average Cost of Capital (WACC)

Note: In Part 1 it is **very unlikely that you will need to calculate the WACC**. It will be given in the problem, and the information below is merely offered for those who would like to know what WACC is.

WACC is the weighted average cost of capital, and it is calculated as the rate made up of the **total cost of long-term funds** (debt and equity) divided by the **fair value** of these long-term funds.

In short, the formula for WACC looks like this:

$$\frac{(\text{Interest paid on Debt} - \text{Effect of Taxes}) + \text{Dividends paid on Shares}}{\text{Average Fair Value of Debt outstanding} + \text{Fair Value of Shares outstanding}} = \text{WACC}$$

If you examine this closely, you will see that we use the **fair value (market value)** of outstanding debt and stock to calculate the WACC, in contrast to our use of the book value of balance sheet accounts in other ratios.

Note: In the calculation of WACC, the total interest cost must take into account the **effect of taxes**. Because interest is a deductible expense, the true cost of interest is the amount of interest expense minus (the tax rate × the interest amount). It could also be calculated as the amount of interest × (1 – the tax rate). This means that the interest expense that is used in the calculation of WACC will be less than the actual interest that was expensed by the company.

Using These Measures

On the Exam, you need to be able to calculate not only the residual income and return-on-investment, but also the individual components of these figures, given a larger set of data.

You also will need to determine how a change in certain things such as income, expenses or interest rate will impact these figures and calculations. In this type of question, it is best to create a simple example, then change the number that the question says changes, and recalculate the answer with the new information.

The main thing you will need to know is to be able to contrast residual income and return-on-investment. The difference is that ROI is focused on % of the return and RI is focused on the \$ of the return. This means that, depending upon the decision criterion, these two methods may lead to different decisions as to which investments to accept or reject.

Role of Accounting Methods on Performance Measurements

Be familiar with the role that accounting policies play in performance measurements. This was discussed in detail in the topic of ROI, but as noted, it is also applicable to RI.

When items such as inventory and fixed assets are used, their values are influenced by the chosen accounting method. For example, in inventory, the value of the inventory can be calculated under the FIFO, LIFO or

weighted average methods. Because any of these different methods can be used to value inventory when a comparison is made between two business units, it is important that both subunits use the same inventory method, because use of different methods will reduce their comparability.

The idea of using the same standards in both subunits is also applicable in any other area where there are different accounting methods that can be chosen. Different methods of recognizing revenues and expenses among different business units and companies can reduce comparability of performance measurements among them. For instance, the use of absorption costing instead of variable costing will cause net income to be higher when inventory increases, because some fixed costs will be capitalized in inventory.

For the Exam, you don't need to be able to calculate the differences that would arise from the use of different accounting methods, but you do need to recognize the issue of comparability that arises from use of the different methods.

Use of Average Balances for Assets and Liabilities

Balance sheet items are as of a moment in time, whereas an income amount covers a period of time. When we are using an income figure and relating that to a balance sheet item such as total assets or debt outstanding, it is customary to use the **average** balance of the balance sheet item during the same period as the income figure covers. This makes the income amount and the balance sheet amount applicable to the same period of time.

This average balance of a balance sheet item is usually calculated as the average of the balances for the beginning and the ending of the period. For example, average total assets for the year 2010 will be the average of year-end total assets for the years 2009 and 2010 (since total assets at year-end 2009 are the same as total assets at the beginning of 2010).

In addition, if the income amount is for less than one year, such as for one quarter, it is customary to **annualize** it. In other words, if we have an income amount for only a single quarter, we would multiply that quarterly income figure by 4 to determine what the income would be for the entire year if that level of income were to continue for one full year. The average balance of the balance sheet item used in the denominator should be the average for only the period (month, quarter, whatever) that the income item pertains to, though. **It is especially important to annualize income when an annual percentage rate of return is being calculated.**

Performance Measurement in Multinational Companies

When a company operates in different countries, it creates additional difficulties in comparing the performance of its operating divisions.

- Governments in many countries impose controls and limit selling prices of a company's products.
- Taxes vary across countries.
- Tariffs and custom duties may be imposed that restrict the import of certain goods.
- Availability and costs of labor, materials and infrastructure vary among countries.
- Economic, legal, political, social and cultural environments vary significantly from country to country.
- Different divisions in different countries account for their operations and performance in different currencies. Exchange rate fluctuations and inflation can significantly affect reported results.
- Assets in foreign countries may be subject to expropriation risk, increasing the business risk of the subunit substantially.

In order to compare performance measures across countries, adjustments are necessary.

Foreign Currency Calculation of ROI

Should a foreign division's ROI be calculated in the division's currency of record, or in the U.S. dollar? If senior management wants to compare that division's performance with one in another country, how can they do that?

If inflation in one country is higher than in another country and prices charged in the high inflation country have been increased because of the inflation, then the ROI of the division in that country calculated in that country's currency will be inflated, as well. To make the comparison of the two divisions more meaningful, both divisions' income should be restated into U.S. dollars at the **average exchange rate** that was in effect during the year. This will eliminate any increase in operating income in the local currency of the division in the high inflation country that is strictly a result of the country's high inflation rate. One of the factors that determines the currency exchange rate between any two nations is the difference between their inflation rates. Therefore, conversion of both divisions' incomes to U.S. dollars at the average exchange rate between each country's currency and the U.S. dollar during the period will eliminate the distortion caused by high inflation in one of the countries and make the two divisions' incomes comparable.

The divisions' assets should be restated into U.S. dollars at the **exchange rate that was in effect when the assets were acquired**. Using later exchange rates for the assets would be inaccurate, because those later exchange rates would incorporate the inflation.

Example: Fun In the Sun Resorts of Phoenix, Arizona, a U.S. company, invests in a resort property in Rio de Janeiro. The exchange rate on the date of the investment, December 31, 2008, was R\$2.356 BRL (Brazilian Reals) = \$1 USD. The amount of the investment was R\$1,500,000 BRL. During 2009, operating income of the Rio de Janeiro resort is R\$300,000.

During the same period, the operating income of the Phoenix resort was \$500,000 USD, and the average investment in that resort was \$2,000,000.

During 2009, the U.S. Dollar declined in value against the Brazilian Real. At year end, the exchange rate was R\$1.570 = \$1 USD. Over the one-year period, the average exchange rate is R\$1.963 BRL = \$1 USD.

2009 ROI for the Phoenix resort property is $\$500,000 \div \$2,000,000$, or .25. 2009 ROI for the Rio de Janeiro resort property in Brazilian Reals is $\text{R}\$300,000 \div \text{R}\$1,500,000$, or .20. It appears that the Phoenix property's ROI is considerably higher than the Rio de Janeiro property's ROI.

However, when the Rio de Janeiro property's income and investment amounts are restated into U.S. Dollars, here is what its ROI becomes:

The Rio de Janeiro property's income is restated using the average exchange rate for the year of R\$1.963 BRL = \$1 USD. Income is therefore $300,000 \div 1.963$, which equals \$152,827. Investment is restated using the exchange rate in effect when the investment was made, which was R\$2.356 = \$1 USD. Investment is therefore $1,500,000 \div 2.356$, which equals \$636,672.

The ROI for the Rio de Janeiro property, stated in U.S. Dollars, is $\$152,827 \div \$636,672$, or .24. Now, the ROIs for the two properties are very comparable (.25 versus .24).

Note that we did not use **average** investment to calculate the ROI for the Rio de Janeiro resort. We assumed that the original investment made on December 31, 2008 did not change during 2009. If we had assumed that investment had changed during the year, we would have had to use the exchange rate for each increase in investment on the date the additional investment was made and used the daily balances to calculate a daily average investment to use as the denominator. That much detail would be outside the scope of the exam.

Multiple Measures of Performance and the Balanced Scorecard

The trend today is to use a more encompassing method of evaluation and include not only financial measures, but also non-financial measures by looking at the overall contribution to the achievement of company goals. This is called a **balanced scorecard**.

The balanced scorecard is a strategic management tool which developed as a response to problems caused by evaluating managers only on the quarterly or annual financial performance of their business units. If managers are evaluated and rewarded for one thing (short-term financial performance), it results in their focus on that one thing, often to the detriment of other dimensions which are equally, if not more, important for improved long-term financial performance. For example, a focus on cost containment in order to improve quarterly results can result in a loss of quality due to lower quality parts being used. The long-term result of loss of quality is loss of customers and, ultimately, can be loss of the business.

The balanced scorecard encourages managers to focus on elements of **long-term success** instead of on short-term financial performance by rewarding them for improvements in those elements of long-term success. While it does use financial measurements, it also uses non-financial and operational indicators which measure basic performance of the company and improvements that it is making in those indicators. Improvements in these non-financial measures provide the prospect of increased future economic value for shareholders. When managers are evaluated and rewarded based on these non-financial indicators, it leads to long-term financial performance improvements. This again comes back to the idea of goal congruence and making sure that everyone is working toward the same goals.

Each company needs to develop its own set of metrics and means to assess continual improvement, and they will probably be different for different divisions and departments within the same company. However, the metrics fall into four broad categories of performance indicators, known as **perspectives**.

The four perspectives are:

- 1) **Financial perspective**, focusing on profitability. Financial performance is still a priority, but it is recognized that good long-term financial performance will not be achieved if goals in the other categories are not attained. Some of the more common measures of financial performance are: operating income, revenue growth, revenue from new products, gross margin percentage, cost reductions, EVA and ROI.
- 2) **Customer perspective**. Developing the company's customer perspective involves identifying the market segment(s) it wants to target and then measuring its success in those segments. A common method of measuring this success is the trend in the company's share of the market over time: is it increasing in line with management goals? Customer satisfaction is another vital part of the customer perspective, because if customers are not satisfied, they will take their business elsewhere. And without customers, a business has no business. Customer satisfaction goals relate to how the company wants its customers to view it. This may include pricing goals (becoming the lowest cost supplier); meeting the customers' needs better than the competition; and/or being known for high quality and excellent customer service. Being the lowest cost supplier can be measured by the customer's total cost of using the company's product relative to the customer's total cost to use competitors' products. How well customers' needs are being met can be measured by the number of repeat customers and the percentage of deliveries that are made as promised and when promised. Quality goals can be measured by means of number of defective products returned and the level of product reliability over time. The level of customer service provided after the sale can be measured with customer surveys.
- 3) **Internal business process perspective**, which includes innovation in products and services, innovations and improvements in operations, and customer service/support after the sale. If one of the company's customer goals is to be the lowest cost supplier, that will need to be supported operationally by maintaining efficient, low-cost production, which can be measured by metrics such as the cost of raw materials, the number of employee hours needed to manufacture a unit of product, and plant utilization. Efficient cycle times also keep costs low. Here also is the support for quality in the

product required to meet the customer satisfaction goals. And meeting customers' needs better than the competition is supported by innovations in products and services. Number of new product introductions is one way to measure this. Technological capability for customer service personnel is necessary to be able to provide excellent customer service, and it is also needed in the manufacturing area to be able to manufacture product efficiently. Employee surveys of customer service personnel could be used to determine whether those employees have the information they need immediately available to them, or whether they frequently have to put customers on hold to go search out the information. Percentage of manufacturing processes with advanced controls would be a way of measuring manufacturing technology.

- 4) **Innovation and learning**, which emphasizes an organizational culture that supports employee innovation, growth and development. In today's technological environment, employees need to be continuously updating their skills. Employee capabilities can be improved through employee training programs and measured by means of percentages of employees trained and their evaluations of the training. Learning involves more than training, however. It can include assigning mentors and tutors or having supervisors act as coaches to help employees develop their problem-solving and decision-making skills, thereby empowering them. Employee empowerment can be measured by the percentage of frontline workers who are capable of managing processes.

It is important for the business to select just a few critical measures that are most relevant to its specific business strategy and then to track them rigorously, rather than using many different measurements. These critical measures are called **critical success factors**. They are measures of the aspects of the company's performance that are essential to its competitive advantage and therefore its success. Each company's critical success factors depend on the type of competition it faces. Critical success factors and competitive advantage will be discussed in more detail in Section C in the topic on Business Process Performance.

Different business strategies call for different scorecards, and quality is more important than quantity when developing balanced scorecard measures. Management attention needs to be focused on the few key measures that are the most important to implementation of the company's chosen strategies and not be distracted by measures that are not critical. For instance, in a business where customer service is critical, telephone wait time would be an important measurement to track, as would the level of knowledge and empowerment of customer service personnel, in addition to the availability of needed information to them. As an example, a company that provides printing services using documents prepared and uploaded by the customer to its website needs service people who can access a customer's uploaded files and who are knowledgeable enough to provide technical advice about the proper preparation of those document files to achieve a satisfactory printing job. And it needs enough customer service people and telephone lines to keep customers' wait times to a minimum.

The balanced scorecard uses a concept of a **strategy map** which links these four perspectives together, beginning at the bottom, **innovation and learning**. The goals of the innovation and learning perspective contribute to the internal business process perspective, because the staff members use their competencies and strategic awareness to make operational improvements. In turn, the operational improvements made in internal business processes support the goals of the customer satisfaction perspective, since they provide the operations support needed to fulfill the goal of customer satisfaction. And customer satisfaction brings about increased business, increased profits, and improved financial performance. When the company's financial and non-financial measures are linked in this way, the non-financial measures serve as leading indicators of the firm's future financial performance. The strategy map provides a way for all employees to see how their work is linked to the corporation's goals.

Implementing a Balanced Scorecard

Implementation of a balanced scorecard system of performance measurement is most successful when the entire organization is aware of it and supports it. The way the organization communicates the role, the use, and the benefits of the balanced scorecard to its employees is one of the most important factors in its successful implementation. The balanced scorecard needs to be introduced by illustrating the sequence of cause-and-effect relationships – the way the perspectives are linked, and why meeting the goals at the

bottom level makes it possible to meet the goals at the next level up, which in turn make the next level of goals possible, and so forth.

It is important to have senior management support for the program, even as high as the board of directors. The board of directors can have balanced scorecard goals, too. That creates support at the very top of the organization, and the support filters down.

Each business unit and division should be involved in developing its own customized scorecard, based on the company's overall objectives and what that unit needs to do to contribute to those objectives. Just as is true for budget development, involvement of the users builds their support. However, the scorecards as developed by middle managers need to be reviewed and approved with input from senior management to make sure they are congruent with the company's goals.

The actual scorecard report for a business unit should be organized according to the four perspectives, with each selected scorecard measure on a line, classified within its perspective. The target can be in one column, followed by the actual results in the next column, and then the actual results versus the target. Results that are in line and out of line can be identified, perhaps by color. Each manager should be accountable for specific lines on each report; and a division head is accountable for all the lines on the divisional report. A good, balanced scorecard report can also identify tradeoffs that managers might make by, for instance, reducing R&D spending in order to achieve short-run financial goals, or making other tradeoffs that could hurt future financial performance. The decline of R&D spending or other problems would be signaled.

The balanced scorecard needs to be marketed to both management and staff to get their support. Internal promotion of the program should take place through various media, such as print, verbal and electronic means.

A brochure can be used to explain how the balanced scorecard will help achieve the company's long-term goals in a way that simply tracking financial performance cannot. Employee newsletters can be utilized to feature the balanced scorecard program and report on results. If improvement in market share is one of the metrics and market share improves, an article can appear about that, explaining what factors created the positive results – including goals met in the perspectives below. On the other hand, if a metric is not met, an article can explain why and outline a plan to correct the situation. Verbal communication can occur in regular employee meetings where management reviews the results and gives employees the opportunity to ask questions. One-on-one conversations between supervisors and employees can give the people who do the jobs an opportunity to point out weaknesses in the program. Suggestion systems, programs inviting employee comments, and employee training programs with reports can also be used to enlist employee support. However, employees need to know that management is taking their ideas seriously, responding to them, and rewarding them appropriately for their ideas. If employee suggestions are ignored, employees will shrug and decide that this is just another program and why should they try to tell management anything, because nothing ever changes. Managers must be willing to listen to criticism and to make changes.

General results can be posted on the company's intranet, with links to the overall corporate goals that each balanced scorecard result supports. In addition to general results available to all employees, the company can give password intranet access to detailed results to senior managers for their use in decision making. All employees can be linked to the goals by linking their bonuses to them. Aligning balanced scorecard results with compensation maximizes their use and effectiveness.

Balanced Scorecard Reporting

Software can be used to provide balanced scorecard performance information to the people who need it. However, installing dedicated balanced scorecard software does not mean that the balanced scorecard has been implemented. A business must develop its own balanced scorecard for each perspective and undertake the implementation project as covered in the previous discussion. But once that has been done, specialized software is available to track the results.

Problems With Balanced Scorecard Use

There are several problems with using the balanced scorecard approach to performance evaluation:

- It is difficult to use scorecards to make comparisons across business units, because each business unit has its own scorecard. Scorecard evaluation is more effective when used to judge the progress of an individual business unit relative to the prior year or to the goal rather than when used to compare a manager's performance with other managers.
- In order to implement balanced scorecard performance measurement, a firm must have extensive **enterprise resource planning** systems to capture the detailed information required.
- Non-financial data is not subject to control or audit and thus its reliability could be questionable.

However, whether used for individual performance evaluation or not, the balanced scorecard is still a very effective method of developing strategy and evaluating progress toward meeting goals.

Customer and Product Profitability Analysis

The ability to evaluate a specific customer or group of customers' profitability to the firm is important, because the 80-20 rule is operative: 80% of profits usually come from the top 20% of a firm's customers. Furthermore, the customers in the bottom 20% of a firm's customers are usually completely **unprofitable**. To maintain competitive advantage, a company needs to work hard to attract profitable customers and keep them; and it needs to work equally hard to discourage the unprofitable customers from continuing to drag down profits. Profitable customers can be attracted and kept through outstanding customer service; and unprofitable customers can be discouraged with fewer discounts and promotional offers.

Customer profitability analysis can be used to determine the profitability of each customer or group of customers. This analysis enables managers to manage their customers' costs-to-serve. A manager might want to reprice activities that cause high costs-to-serve or reduce available services for customers that are high cost-to-serve. To customers that are identified as low cost-to-serve, the manager can offer discounts in order to increase the sales volume from those customers. The most profitable customers can be provided with improved customer service in order to maintain them as customers.

If a particular customer is unprofitable because of the particular products or services being purchased, the manager may be able to shift that customer's mix toward higher-margin products and services, thereby converting that customer into a profitable customer.

Customer profitability information can be used for targeted marketing, as well. It can reveal the types of customers that the company wants to market to and the types it does not want to market to.

An example of customer profitability information is data generated in a bank concerning the services being used by each business customer. Many banks use account analysis to determine the total fees to charge their business customers. The bank analyzes the average balance on loans outstanding, the interest rate being charged, and its cost for the funds lent out to that customer. A large commercial customer might use cash management services such as lockbox or concentration banking, and providing those services generates costs for the bank, such as an allocated portion of the cash management operations employees' salaries and facility costs. The checking account deposits that the commercial customer keeps in the bank do not pay interest to the customer, but the average balance of the funds is available to the bank to invest in loans to other customers. All of this is put together into an account analysis for each customer each month, and the analysis process generates the monthly fee that should be charged the customer. The account analysis report goes out to the customer along with the monthly fee invoice, and if a customer wants to decrease its future monthly fees, it can increase the amount of non-interest bearing deposits it keeps on deposit with the bank.

Product profitability analysis is just as important as customer profitability analysis. Product profitability analysis can identify products and services that are unprofitable so those products and services can be either repriced or discontinued and replaced with new products and services that are more profitable.

When customers and products are being evaluated for their profitability, accurate allocations of common costs are critical. Several methods of allocating common costs will be discussed in the next section, Section C, on Cost Management. ABC Costing is particularly useful.

Section C – Cost Management

This section represents 25% of the Part 1 Exam. This section focuses on the process of determining and also ways of controlling how much it costs to produce a product. This includes several types of cost accumulation and cost allocation systems as well as sources of operational efficiency and business process performance for a firm. An important concept in the business process performance portion is the concept of competitive advantage and how a firm can attain it. Major topics include:

- Variable and Absorption Costing,
- Joint-product and Byproduct Costing,
- Process Costing,
- Job Order Costing,
- Life-cycle Costing,
- Overhead Cost Allocation,
- Activity-based Costing,
- Estimating Fixed Costs,
- Operational Efficiency, and
- Business Process Performance.

In the area of costing systems, the three that are the most complicated are:

- 1) Variable and Absorption Costing,
- 2) Process Costing, and
- 3) Activity-based Costing.

This is not to say that the others are not important or will not be tested, but simply that these three are where you will need to spend more time to ensure that you fully understand them for the Exam.

Classifications of Costs

The first thing that needs to be covered for this Section is a number of terms and concepts related to the different classifications of costs. This is a large element of the Exam (both directly and indirectly) and as such, it is important that from the very beginning a candidate understands the different types, classifications and treatments of costs.

Costs Based on Level of Production

In the following table are the main groups of costs **based on their behavior as the level of production changes**. For these three types of costs you need to know both how the cost per unit changes and how the total cost changes as the level of production changes.

Fixed costs	Fixed costs do not change within the relevant range of production. The total amount of these costs does not change with a change in production . However, the cost per unit decreases as production increases .
Variable costs	Variable costs are those that are incurred only when a product is made, such as material or labor. The per unit variable cost remains unchanged as production increases or decreases while total variable cost increases as production increases and decreases as production decreases . Note: In reality, variable costs per unit may change as production increases. This is caused by discounts that are received when more units are purchased as a result of larger production volume. However, this effect is not relevant in our discussion of variable costs for the Exam.
Mixed costs	These are costs that have both a fixed and a variable component. An example is a mobile phone. You pay a certain fixed amount each month and then a variable amount for each call that you make.

Having looked at the above table and the basics of these classifications, we will now examine in greater depth the different ways in which fixed and variable costs behave in the production process as production level changes. It is important that you know how total costs and costs per unit change as production changes. This fundamental behavior of fixed and variable costs is used in other sections of Part 2 as well as in other Exams. Although this is not inherently difficult, we will look in more detail at this subject because it is such an underlying element of the process.

Variable Costs

Variable costs are those costs that are incurred only if the company actually produces something. This means that if a company produces no units (sits idle for the entire period), there will be no variable costs incurred by the company. Direct material and direct labor are usually variable costs. There are some situations, however, in which direct labor may be a fixed cost.

As production level increases, the **total amount of variable costs will increase**, but the **variable cost per unit will remain unchanged**.

Note: This topic will be covered in many other areas of the Exams, and is only presented here for awareness purposes. The selling price minus all variable costs is equal to the **unit contribution**. Contribution is the amount from the sale that the company is able to put towards the covering of fixed costs or profit after the variable costs have been covered. **Contribution margin** is a measure of contribution as a percentage of the sales price.

Fixed Costs

Fixed costs are costs that do not change as the level of production changes – within a relevant range. **The relevant range is the range of production in which the cost is fixed.** This means that within the relevant range, an increase in the units produced will not cause an increase in the total fixed costs.

Fixed costs are best described by looking at a factory as an example. A factory has the capacity to produce a certain number of units. As long as production is between 0 and that number of units, the cost for the factory will remain unchanged. However, once the level of production exceeds the capacity of the factory, the company will need to build (or otherwise acquire) a second factory. This will increase the fixed costs as the company moves to another relevant range.

Within the relevant range of production the **total fixed costs will remain unchanged**, but the **fixed costs per unit will decrease as the level of production increases**.

Note: Over a large enough time period, all costs will behave like variable costs. In the short term, some costs may be fixed (such as a factory), but over a longer period of time, the company may be able to change its factory situation so that the factory cost also becomes variable.

Mixed Costs

In reality, many costs are a combination of fixed and variable elements. These are mixed costs. Mixed costs may be **semi-variable** costs or **semi-fixed** costs.

A **semi-variable cost** has both a fixed component and a variable component. There is a basic fixed amount that must be paid regardless of activity, even if there is no activity. And added to that fixed amount is an amount which varies with activity. Utilities are an example. Some basic utility expenses are required just to maintain a factory building, even if no production is taking place. Electric service, water service, and other utilities usually must be continued. So that basic amount is the fixed component of utilities. If production begins (or resumes), the cost for utilities increases by a variable amount, depending upon the production level. But the fixed amount does not change. Another example of a semi-variable cost is a salesperson who receives a base salary plus a commission for each sale made. The base salary is the fixed component of the salesperson's salary, and the commission is the variable component.

A **semi-fixed cost** is fixed over a given, small range of activity, and above that level of activity, the cost suddenly jumps. It stays fixed again for a while at the higher range of activity, and when the activity moves out of that range, it jumps again. A semi-fixed cost moves upward in a step fashion, staying at a certain level over a small range and then moving to the next level quickly. All fixed costs behave this way, and a wholly fixed cost is also fixed only as long as activity remains within the relevant range. However, a semi-fixed cost is fixed over a smaller range than the relevant range of a wholly fixed cost. An example of a semi-fixed cost is the nursing staff in a hospital. If the hospital needs one nurse for every 25 patients, then each time the patient load increases by 25 patients, one additional nurse will be hired and total nursing salaries will jump by the additional nurse's salary. That is in contrast to administrative staff salaries at the same hospital, which might remain fixed until the patient load increases by 250 patients, at which point an additional admitting clerk would be needed. The administrative staff salaries are wholly fixed costs (over the relevant range), whereas the nursing staff salaries are semi-fixed costs.

The difference between a semi-variable and a semi-fixed cost is that the semi-variable cost starts out at a given base level and moves upward smoothly from there as activity increases. A semi-fixed cost moves upward in steps.

Production vs. Period Costs

In addition to the classification of costs based on their behavior as production changes, costs can also be classified based on their purpose. The main distinction of costs that are based on purpose is that of Production (or Product) Cost vs. Period Cost. It is important to know this.

Note: Period costs can be fixed or variable, and production costs can be fixed or variable. So these different classifications are not mutually exclusive from each other.

Product Costs or Inventoriable Costs

Product costs (also called inventoriable costs) are those costs that go directly into the production process, without which the product could not be made. Product costs are 'transferred' to each unit and will be carried on the balance sheet as inventory when production is completed. When the item is sold, the cost will be transferred from the balance sheet to the income statement where it is classified as cost of goods sold, which is an expense.

The main types of product costs are: 1) **materials** (both direct and indirect); 2) **labor** (both direct and indirect); and 3) **manufacturing overhead** (both fixed and variable). These different product costs can be combined and given different names as outlined in the tables below. You need to know what types of costs are included in the different classifications.

Note: This definition of product cost is in accordance with financial reporting purposes. However, there are also other types of "product costs" for pricing and other purposes, and we will take a look at those later in this section.

Types of Product Costs

This table includes the **main costs** that are incurred in the production process.

Direct labor	These are the costs of labor that can be directly traced to the production of a unit. Assembly line workers are direct labor costs for a manufacturing company, and the compensation of an auditor is direct labor for an auditing firm.
Direct material	These are the materials that are directly put into the finished product. The costs included in the direct material cost are all of the costs associated with acquiring it – the item itself, shipping, insurance and taxes, among others. Common examples of direct materials are plastic and components.
Manufacturing overhead	These are the company's costs related to the production process that are not direct material or direct labor, but are necessary costs of production. Examples are indirect labor, indirect materials, rework costs, electricity and other utilities, depreciation of plant equipment, and factory rent.
Indirect labor	Indirect labor is the labor that is part of the overall production process but doesn't come into direct contact with the product. The maintenance department is a common example. Indirect labor is a manufacturing overhead cost.
Indirect material	Similar to indirect labor, indirect materials are materials that are not the main components of the finished goods. Examples are glue, screws and nails and other materials that may not even be physically incorporated into the finished good (machine oils, lubricants, and miscellaneous supplies). Indirect materials are a manufacturing overhead cost.

Groupings of Product Costs

The five main types of product costs in the previous table can be further combined to create different cost classifications. The three classifications that you need to be aware of are in the following table.

Prime costs	Prime costs are the costs of direct material and direct labor . These are the direct inputs.
Manufacturing costs	Manufacturing costs include the prime costs and manufacturing overhead applied . These are all of the costs that need to be incurred in order to actually produce the product. This does not include selling or administrative costs, which are period costs.
Conversion costs	Conversion costs include manufacturing overhead (both fixed and variable) and direct labor . These are the costs that are required to convert the direct materials into the final product.

Period Costs, or Nonmanufacturing Overheads

Period costs, as compared to product costs, are not involved in the production of the product. Even if these costs were not incurred the product could still be manufactured. Period costs are usually expensed when they are incurred.

The number of period costs is almost unlimited because period costs include essentially everything other than the product costs (all costs have to be either a product cost or a period cost). These include selling and administration costs as well as other similar departments' costs.

Period costs can be variable, fixed or mixed, but they are not included in the calculation of cost of goods sold or cost of goods manufactured (both of these are covered later). As stated above, **for financial reporting purposes, these costs are expensed** to the income statement as they are incurred.

However, **for internal decision-making, some period costs may be allocated to the production departments and then to the individual units**. This is done so that the company can set a price for each product that covers all of the costs the company incurs. We will discuss this type of allocation in the topic of Service Cost Allocation.

The number of classifications of period costs that a company can use on its income statement will depend upon that company. Examples include general and administrative, selling, accounting, depreciation (of nonproduction facilities), and so on.

Other Costs and Cost Classifications

In addition to all of the costs and classifications listed above, there are some more types of costs with which a candidate must be familiar.

Opportunity costs	An opportunity cost is the contribution to income that is lost by not using a limited resource in its best alternative use. When calculating the opportunity cost, it includes only the expenditures that would not be made in the other available alternatives and/or the contribution that would have been earned if an alternative decision had been made. Any time that money is invested or used to purchase something, there is lost return from the next best use of that money. Often times, that lost return is interest. If the money had not been used to purchase inventory, for example, it could have been deposited in a bank and earned interest. The lost interest can only be calculated for the time period during which the cash flows are different between the two options.
Carrying costs	These are the costs that the company incurs when it carries inventory. Carrying costs include: rent and utilities related to storage; insurance and taxes on the inventory; costs of employees who manage and protect the inventory; damaged or stolen inventory; the lost opportunity cost of having money invested in inventory; and other storage costs. Because storage does not add value to the items themselves, storage costs are expensed on the income statement as incurred. They are not included in inventory (in other words, they are not included in the balance sheet).
Sunk costs	These are costs that have already been incurred and cannot be recovered. Sunk costs are irrelevant in the decision-making process because of the fact that they have already been incurred and no present or future decision can change that fact.
Committed costs	Committed costs are costs for the company's infrastructure. They are costs required to establish and maintain the readiness to do business. Examples would be intangible assets such as a franchise and fixed assets such as property, plant and equipment. They are fixed costs that are usually on the balance sheet as assets and become expenses in the form of amortization and depreciation.
Discretionary costs	These are costs that may or may not be spent, at the decision of a manager. In the short term, discretionary costs will not cause an adverse effect on the business if they are not incurred, but in the long run they do need to be spent. These are cost decisions that are made periodically and are not closely related to input or output decisions. Furthermore, the value added and the benefits obtained from spending the money cannot be precisely defined. Advertising, research and development (R&D) and employee training are usually given as examples of discretionary costs. Discretionary costs may be fixed costs, variable costs, or mixed costs.
Marginal costs	These are the costs necessary to produce one more unit.
Engineered costs	Engineered costs are costs that have a definite physical relationship to the activity base or measure. They result from activities that have well defined cause and effect relationships between inputs and outputs and between costs and benefits. Direct materials and direct labor are engineered costs, as are indirect resources that vary with product specifications and production volume. The value added by activities associated with engineered costs is fairly clear and easy to measure. Engineered costs are variable costs in their cost behavior.
Imputed costs	An imputed cost is a cost that does not exist but is needed for use in a decision-making process. Interest or a cost of capital is often an imputed cost. For example, in a loan that does not have a stated interest rate, an interest rate will often be imputed to determine the cost of the loan. This imputed rate is assumed, and is based on the market rate or rates for similar loans. It does not exist, but is necessary for use in decision-making.

Note: When **overtime** must be worked, the overtime premium (this is the amount that the wage increases for overtime work) that is paid to the workers is considered to be factory overhead.

However, if the need to work overtime is the result of a specific job or customer request, the premium should be charged to that specific job and not included in the overall amount to allocate.

The following information is for the next four Questions: The estimated unit costs for a company using absorption (full) costing and planning to produce and sell at a level of 12,000 units per month are as follows.

<u>Cost Item</u>	<u>Estimated Unit Cost</u>
Direct materials	\$32
Direct labor	20
Variable manufacturing overhead	15
Fixed manufacturing overhead	6
Variable selling	3
Fixed selling	4

Question 94: Estimated conversion costs per unit are:

- a) \$35
- b) \$41
- c) \$48
- d) \$67

Question 95: Estimated prime costs per unit are:

- a) \$73
- b) \$32
- c) \$67
- d) \$52

Question 96: Estimated total variable costs per unit are:

- a) \$38
- b) \$70
- c) \$52
- d) \$18

Question 97: Estimated total costs that would be incurred during a month with a production level of 12,000 units and a sales level of 8,000 units are:

- a) \$692,000
- b) \$960,000
- c) \$948,000
- d) \$932,000

(CMA Adapted)

Cost of Goods Sold (COGS) and Cost of Goods Manufactured (COGM)

Now that we have looked at all of the different classifications of costs and their different behaviors, we will turn our attention to using these different costs in accounting calculations. We will examine the calculation of the cost of goods sold (COGS) and the cost of goods manufactured (COGM). Though these two items are somewhat similar, they are very different in one key respect. COGS is an external reporting figure and it will be reported on the income statement. It is the cost of producing the units that were actually sold during the period. COGM, on the other hand, is an internal number and is not reported on either the balance sheet or the income statement. It represents the cost of the goods that were completed during the period. COGM is, however, used in the calculation of the cost of goods sold for a company that produces its own inventory. The calculation of both numbers is looked at in more detail below.

The process of calculating the cost of producing an item is a very important one for any company. It is critical that the cost that is calculated represents the complete cost of production. If the company does not calculate the cost of production correctly, it will charge a price for the product that will be incorrect. The result will be either low sales if the price is too high or low profits if the price is too low.

Additionally, as we have already covered, it is this production cost that will be included in the balance sheet as the value of inventory when the item is completed. When the item is sold, these costs will be transferred to the income statement as cost of goods sold. Costs that are not production costs are period costs, and they are generally expensed as incurred (for example: carrying costs, general and administrative costs, and so on).

Due to this need to determine the cost of production accurately, the information that accountants provide to management regarding the costs of the company is crucial. Furthermore, it is beneficial to provide this information quickly and often, so that the company can make any necessary corrections to pricing as soon as possible.

Calculating Cost of Goods Sold

COGS represents the cost to produce or purchase the units that were sold during the period. It is perhaps the largest individual expense item on the income statement. As such, it is important that this amount is calculated accurately.

COGS is calculated using the following formula:

$$\begin{array}{rcl} & \text{Beginning finished goods inventory} & \\ + & \text{Purchases or cost of goods manufactured} & \\ - & \text{Ending finished goods inventory} & \\ = & \text{Cost of Goods Sold} & \end{array}$$

This written formula is a simplification of what is actually occurring in reality in that it assumes all of the units were either sold during the period or were still in ending inventory. This does not always happen in reality because units may be damaged, stolen or lost. However, for the Part 2 Exam, this formula is sufficient.

Calculating Cost of Goods Manufactured

The COGM represents the cost of the units completed and transferred out of work-in-process during the period. For a manufacturing company this amount will be part of the cost of goods sold calculation. COGM does not include the cost of work that was done on units that were not finished during the period.

COGM is calculated using the following formula:

$$\begin{array}{rcl} & \text{Direct Materials Used*} & \\ + & \text{Direct Labor Used} & \\ + & \text{Manufacturing Overhead Applied} & \\ = & \text{Manufacturing Costs Incurred During the Period} & \\ + & \text{Beginning Work-in-process Inventory} & \\ - & \text{Ending Work-in-process Inventory} & \\ = & \text{Cost of Goods Manufactured} & \end{array}$$

* Direct Materials Used = Beginning Direct Materials Inventory + Purchases + Transportation-In – Net Returns – Ending Direct Materials Inventory

As was the case with the COGS formula above, this formula simplifies reality because it assumes that all items of inventory are either used or are in ending inventory. In reality some of the inventory may have been lost, damaged or otherwise not used, and therefore it is not in ending inventory. However, for the purposes of the Exams, this formula is sufficient.

Variable and Absorption Costing

Variable and absorption costing are simply two different ways of determining the cost of production and presenting the income statement. Despite the fact that these are often presented as opposite to each other, there are only two differences between them that you need to know about, which are:

- 1) The treatment of **fixed factory overhead** costs (for example, factory rent), and
- 2) The **presentation on the income statement** of different costs.

Note: All other costs except for fixed factory overheads are treated in the same manner under both of these methods, but they may be reported in a different manner on the income statement.

We will first look at the difference in the treatment of fixed factory overheads under each of these two methods, and then we will look at the income statement presentation under each method.

Fixed Factory Overheads Under Variable Costing

Under variable costing (also called **direct costing**), fixed factory overheads are a period cost that are expensed in the period when they are incurred. This means that no matter what the level of sales, all of the fixed factory overheads will be expensed in the period when incurred.

Fixed Factory Overheads Under Absorption Costing

Under absorption costing, fixed factory overhead costs are **allocated to the units produced during the period** according to some predetermined ratio and are therefore a product cost. Under the absorption method, the profit of a company is influenced by the difference in the level of production and the level of sales. When the level of production is higher than the amount of sales, some of the fixed manufacturing overhead costs from this period are included in the balance sheet as inventory at the year-end. As a result, these costs that are in inventory are not included in the income statement as an expense. We will look at this in more detail on the following page.

For external reporting purposes, **GAAP requires the use of absorption costing**. However, many accountants feel that variable costing is a better tool to use for analysis, and therefore variable costing is often used internally. (Job-order costing, process costing and activity-based costing can be used for external purposes.)

Note: It is important to remember that the only difference in the profit between these two methods relates to the treatment of **fixed factory overheads**. Under absorption costing, fixed factory overhead costs are included, or absorbed, into the product cost. Under variable costing, they are excluded because they are not a variable cost.

Question 98: Which of the following statements is true for a firm that uses variable costing?

- a) The cost of a unit of product changes because of changes in the number of manufactured units.
- b) Profits fluctuate with sales.
- c) An idle facility variation is calculated.
- d) Product costs include "direct" (variable) administrative costs.

(CMA Adapted)

Effects of Changing Inventory Levels

It is most certain that these two methods (variable and absorption) will calculate different amounts of income or loss for the **same period of time** because in using them, different items are included in the product cost (inventoried), and different amounts are expensed in the period. In addition to giving different amounts of profit, these two methods will also give different values for ending inventory. The differences between these methods arise when inventory levels change during a period, meaning that the level of sales did not equal the level of production.

Only when **production and sales are equal** in a period (meaning that there is no change in inventory levels and everything that was produced was sold) will there not be a difference between the incomes reported under these two methods. This is because all of the fixed factory overheads were expensed as a period cost under the variable method, and all of the fixed factory overheads were 'sold' and included in cost of goods sold under the absorption method.

Production Greater than Sales (Inventory Increases)

If production is greater than sales, then the **income calculated under the absorption method is greater** because some of the fixed factory overheads were inventoried under this method. Similarly, this will mean that the ending inventory value will be greater using the absorption method because of the fixed factory overhead costs that were inventoried.

Sales Greater than Production (Inventory Decreases)

If production is lower than sales, then the **variable method will give a greater income** because the only fixed factory overheads included as an expense in this period were those that were incurred during the year. Because sales were greater than production, it was necessary to sell some of the products that were produced in previous years. This means that under the absorption method, some of the fixed factory overhead costs that had been inventoried in previous years will now be expensed in the current period.

Note: You should recognize that over a long period of time, the total income that will be presented under both methods will be essentially the same. In the long term these two methods do not differ in total income (because in the long term the company will not produce more than it can sell and therefore sales will equal production). Rather, the difference between them will appear in the allocation of income to the different periods within that longer time period.

The following table outlines the effect of changing inventory levels (production compared to sales) under the two methods:

<u>Profit</u>	
Production = Sales	Absorption = Variable
Production > Sales	Absorption > Variable
Production < Sales	Absorption < Variable

Note: Ending inventory under absorption costing will **always be higher** than ending inventory under variable costing, because there are more costs in each unit under absorption costing, and the number of units in ending inventory are the same under both methods. There will always be some **fixed** costs in ending inventory under absorption costing that will not be in ending inventory under variable costing.

Income Statement Presentation

As mentioned earlier, there is also a difference in the presentation of the Income Statement with these two methods.

The Income Statement under Absorption Costing

Under absorption costing we will calculate a **gross margin** by subtracting **all variable and fixed manufacturing costs** (this being COGS) from revenue. All variable and fixed nonproduction costs are then subtracted from the gross margin to calculate net income.

The pro forma income statement under absorption costing looks as follows:

Sales revenue	
–	<u>(Cost of goods sold)</u> – made up of variable and fixed manufacturing costs
=	Gross margin
–	(Variable nonmanufacturing costs)
–	<u>(Fixed nonmanufacturing costs)</u>
=	<u>Operating Income</u>

The Income Statement under Variable (Direct) Costing

Under variable costing we will calculate a **manufacturing contribution margin** by subtracting all **variable manufacturing costs** from revenue. From this manufacturing contribution margin, we subtract nonmanufacturing variable costs to arrive at the **contribution margin**. All fixed costs (manufacturing and non-manufacturing) are then subtracted from contribution margin to calculate net income.

The pro forma income statement under variable costing looks as follows:

Sales revenue	
–	<u>(Variable manufacturing costs)</u>
=	Manufacturing contribution margin
–	<u>(Variable nonmanufacturing costs)</u>
=	Contribution Margin
–	(Fixed manufacturing costs)
–	<u>(Fixed nonmanufacturing costs)</u>
=	<u>Operating Income</u>

Note: This cosmetic difference between the two methods does not change the effect of the treatment of fixed manufacturing overheads under the different methods. But, you need to know that the absorption method determines a **gross margin** and the variable method calculates a **contribution margin**.

This is demonstrated in the example (and the answer to the example) on the following page.

While **absorption costing is required for external reporting** (the GAAP financial statements), it is generally thought that **variable costing is better for internal uses**. Some of the reasons that variable costing is believed superior for internal purposes are:

- By not including fixed costs in the calculation of cost to produce, companies are able to make better and more informed decisions about profitability and product mix.
- Operating income is directly related to sales levels and is not influenced by changes in inventory levels due to production or sales variances. This prevents managers from being able to 'hide costs' on the balance sheet by increasing production, thus moving more of the fixed factory overheads to the balance sheet as inventory. Under absorption costing, a manager can increase profits simply by producing more units.
- The use of variance analysis required with absorption costing may be tedious and confusing because of the different way the costs are reported.
- The impact of fixed costs on profit is obvious and visible under variable costing because they are on the income statement and listed as costs.
- It is easier to determine the 'contribution' to fixed costs made by a division or product – and thereby helps determine if the product or division should be discontinued.

Example: Hardy Corp. uses the FIFO method to track inventory. The records for Hardy include the following information:

<u>Inventory</u>	<u>2008</u>	<u>2009</u>
Beginning balance, in units	-0-	4,200
Production	<u>12,000</u>	<u>10,000</u>
Available for sale	12,000	14,200
Less units sold	<u>(7,800)</u>	<u>(12,000)</u>
Ending balance, in units	<u>4,200</u>	<u>2,200</u>
<u>Other information</u>		
Sales (\$2.10 per unit)	\$16,380	\$25,200
Variable mfg. costs (\$.90/unit)	10,800	9,000
Fixed mfg. costs	5,000	5,400
Variable selling and admin. costs	2,250	3,750
Fixed selling and admin. costs	2,250	3,750

Required: Prepare the income statement for 2008 and 2009 using both the absorption and the variable methods of costing. (The solution follows.)

2008 Absorption	<u>\$\$\$</u>	2008 Variable	<u>\$\$\$</u>
Sales revenue		Sales revenue	
		Manuf. Cont. Margin	<u> </u>
Gross Margin	<u> </u>	Contribution Margin	<u> </u>
Operating Income	<u>\$ </u>	Operating Income	<u>\$ </u>
2009 Absorption	<u>\$\$\$</u>	2009 Variable	<u>\$\$\$</u>
Sales revenue		Sales revenue	
		Manuf. Cont. Margin	<u> </u>
Gross Margin	<u> </u>	Contribution Margin	<u> </u>
Operating Income	<u>\$ </u>	Operating Income	<u>\$ </u>

Answer to the Variable/Absorption Costing Example

2008 Income Statements

Absorption Costing		<u>Variable (Direct)</u>	
Sales	\$ 16,380	Sales	\$ 16,380
Variable Mfg Costs	7,020	Variable Mfg Costs	<u>(7,020)</u>
Fixed Mfg Costs	<u>3,250</u>	Manuf Cont Margin	\$ 9,360
COGS	<u>(10,270)</u>	Less: Variable S&A	<u>(2,250)</u>
		Contribution margin	7,110
Gross margin	6,110	Less: Fixed mfg. costs	(5,000)
S&A expenses	<u>(4,500)</u>	Fixed S&A	<u>(2,250)</u>
Operating Income	<u>\$ 1,610</u>	Operating Income	<u>\$ (140)</u>

2009 Income Statements

<u>Absorption Costing</u>		<u>Variable (Direct)</u>	
Sales	\$ 25,200	Sales	\$ 25,200
Variable Mfg Costs	10,800	Variable Mfg Costs	<u>(10,800)</u>
Fixed Mfg Costs 2008 ^l	1,750	Manufacturing	
Fixed Mfg Costs 2009 ^m	<u>4,212</u>	Contribution margin	14,400
COGS	<u>(16,762)</u>	Variable S&A	<u>(3,750)</u>
		Contribution margin	10,650
Gross margin	8,438	Less: Fixed mfg. costs	(5,400)
S&A expenses	<u>(7,500)</u>	Fixed S&A	<u>(3,750)</u>
Operating Income	<u>\$ 938</u>	Operating Income	<u>\$ 1,500</u>

^l Beginning inventory for 2009 was 4,200 units, and those units were produced during 2008. Each unit had \$.4167 of fixed manufacturing cost attached to it ($\$5,000 \text{ fixed manufacturing costs in 2008} \div 12,000 \text{ units produced in 2008}$). Since the company uses FIFO, those units were the first units sold in 2009. $4,200 \text{ units} \times \$0.4167 \text{ of fixed manufacturing cost per unit} = \$1,750$ of fixed manufacturing cost from 2008 production that was sold in 2009.

^m A total of 12,000 units were sold in 2009. As noted above, 4,200 of those units came from 2008's production. That means the remainder, or $12,000 - 4,200 = 7,800$ units, came from 2009's production. Fixed manufacturing cost per unit during 2009 was $\$5,400 \text{ fixed manufacturing costs} \div 10,000 \text{ units produced}$, or \$.54 per unit. So the fixed manufacturing cost included in the units that were sold from 2009's production is $\$.54 \times 7,800 = \$4,212$.

Note: In a situation in which there is **no beginning inventory**, or the **LIFO** inventory assumption is used and ending inventory is higher than beginning inventory (i.e., none of the beginning inventory is sold), it is very easy to calculate the difference between the variable and absorption methods. This can also be used under other inventory cost flow assumptions if the beginning inventories are valued at the same per unit manufacturing cost as the current year's planned per unit manufacturing cost.

Given that the only difference between the absorption and variable methods is the treatment of fixed factory overheads, when the question asks for the **difference in income** between the two methods, if one of the three situations above applies, you simply need to make the following calculation:

$$\begin{array}{rcl}
 & \text{Fixed overhead cost per unit}^n & \\
 \times & \text{Number of units of change in inventory} & \\
 = & \text{Difference in income between the two methods} &
 \end{array}$$

Remember that this works only when (1) there is no beginning inventory (which is often the case in an Exam question), (2) when the LIFO inventory assumption is used and ending inventory is higher than beginning inventory, or (3) under other inventory cost flow assumptions if the beginning inventories are valued at the same per unit manufacturing cost as the current year's planned per unit manufacturing cost.

Question 99: MNance Corp began operations in January. The company produced 50,000 units and sold 45,000 units in its first year of operations. Costs for the year were as follows:

Fixed Manufacturing Costs	\$250,000
Variable Manufacturing Costs	180,000
Fixed General and Selling Costs	75,000
Variable General and Selling Costs	80,000

How would the net income of MNance compare between the variable method and full absorption costing methods?

- a) Variable would be \$25,000 higher.
- b) Absorption would be \$25,000 higher.
- c) Variable would be \$32,500 higher.
- d) Absorption would be \$32,500 higher.

(HOCK)

Question 100: Jansen, Inc. pays bonuses to its managers based on operating income. The company uses absorption costing, and overhead is applied on the basis of direct labor hours. To increase bonuses, Jansen's managers may do all of the following except:

- a) Produce those products requiring the most direct labor.
- b) Defer expenses such as maintenance to a future period.
- c) Increase production schedules independent of customer demands.
- d) Decrease production of those items requiring the most direct labor.

(CMA Adapted)

ⁿ If the inventory level has fallen, you will need to use last year's fixed overhead per unit figure as the "extra inventory" that was sold and produced last year. If inventory has risen, you need to use the current period's fixed overhead per unit.

The following information is for the next two Questions: Osawa planned to produce and actually manufactured 200,000 units of its single product in its first year of operations. Variable manufacturing costs were \$30 per unit of product. Planned and actual fixed manufacturing costs were \$600,000, and the selling and administrative costs totaled \$400,000. Osawa sold 120,000 units of product at a selling price of \$40 per unit.

Question 101: Osawa's operating income using absorption costing is:

- a) \$200,000
- b) \$440,000
- c) \$600,000
- d) \$840,000

Question 102: Osawa's operating income using variable costing is:

- a) \$200,000
- b) \$440,000
- c) \$800,000
- d) \$600,000

(CMA Adapted)

The following information is for the next two Questions:

Product sales:	1,000 units at \$10 each
Variable manufacturing costs:	\$5.50 per unit
Fixed manufacturing overhead:	\$1,200
Variable selling and administrative costs:	\$.50 per unit sold
Fixed selling and administrative costs:	\$1,000
Units produced:	1,200
Beginning inventory	0 units

Question 103: Operating income under variable (direct) costing is:

- a) \$600
- b) \$700
- c) \$1,800
- d) \$2,300

Question 104: Assuming operating income under variable costing is \$1,800, operating income under absorption costing is:

- a) \$1,800
- b) \$1,967
- c) \$2,000
- d) \$2,167

(CIA Adapted)

The following information is for the next six Questions: Valyn Corporation employs an absorption costing system for internal reporting purposes; however, the company is considering using variable costing. Data regarding Valyn's planned and actual operations for the calendar year is:

	<u>Planned Activity</u>	<u>Actual Activity</u>
Beginning finished goods inventory in units	35,000	35,000
Sales in units	140,000	125,000
Production in units	140,000	130,000

The planned per unit cost figures shown in the next schedule were based on the estimated production and sale of 140,000 units for the year. Valyn uses a predetermined manufacturing overhead rate for applying manufacturing overhead to its product; therefore, a combined manufacturing overhead rate of \$9.00 per unit was employed for absorption costing purposes. Any over- or underapplied manufacturing overhead is closed to the cost of goods sold account at the end of the reporting year.

	<u>Planned Costs Per Unit</u>	<u>Planned Total Costs</u>	<u>Incurred Costs</u>
Direct materials	\$12.00	\$1,680,000	\$1,560,000
Direct labor	9.00	1,260,000	1,170,000
Variable manufacturing overhead	4.00	560,000	520,000
Fixed manufacturing overhead	5.00	700,000	715,000
Variable selling expenses	8.00	1,120,000	1,000,000
Fixed selling expenses	7.00	980,000	980,000
Variable administrative expenses	2.00	280,000	250,000
Fixed administrative expenses	<u>3.00</u>	<u>420,000</u>	<u>425,000</u>
Total	<u>\$50.00</u>	<u>\$7,000,000</u>	<u>\$6,620,000</u>

The beginning finished goods inventory for absorption costing purposes was valued at the previous year's planned unit manufacturing cost, which was the same as the current year's planned unit manufacturing cost. There are no work-in-process inventories at either the beginning or the end of the year. The planned and actual unit selling price for the current year was \$70.00 per unit.

Question 105: The value of Valyn Corporation's current year actual ending finished goods inventory under the absorption-costing basis was:

- a) \$900,000
- b) \$1,200,000
- c) \$1,220,000
- d) \$1,350,000

Question 106: The value of Valyn Corporation's actual ending finished goods inventory on the variable costing basis was:

- a) \$1,400,000
- b) \$1,125,000
- c) \$1,000,000
- d) \$750,000

Question 107: Valyn Corporation's total fixed costs expensed under the absorption costing basis were:

- a) \$2,095,000
- b) \$2,120,000
- c) \$2,055,000
- d) \$2,030,000

Question 108: Valyn Corporation's actual manufacturing contribution margin calculated under the variable costing basis was:

- a) \$4,375,000
- b) \$4,935,000
- c) \$4,910,000
- d) \$5,625,000

Question 109: The total variable cost currently expensed by Valyn Corporation under the variable costing basis was:

- a) \$4,375,000
- b) \$4,500,000
- c) \$4,325,000
- d) \$4,550,000

Question 110: The difference between Valyn Corporation's operating income calculated on the absorption costing basis and calculated on the variable costing basis was:

- a) \$65,000
- b) \$25,000
- c) \$40,000
- d) \$90,000

(CMA Adapted)

Question 111: When a firm prepares financial reports using absorption costing:

- a) Profits will always increase with increases in sales.
- b) Profits will always decrease with decreases in sales.
- c) Profits may decrease with increased sales even if there is no change in selling prices and costs.
- d) Decreased output and constant sales result in increased profits.

(CMA Adapted)

Joint Products and Byproducts

Joint Products

Joint products occur when one production process leads to the production of two or more similar finished products. These products are not exactly identical, but they share the same production process up to what is called the **splitoff point**. This is the point at which the two products stop sharing the same process and become different, identifiable products.

An example of joint products would be the processing of pineapple. As a pineapple goes through processing at the factory it may become juice or pineapple slices that will be canned. These are two products that are arising from the same process and as such the joint costs of processing the pineapple need to be allocated to the juice and to the slices.

The main issue with joint products is how to account for the **joint costs** (those costs incurred prior to the splitoff point) and how to allocate these costs to the different products. Joint costs may include direct materials, direct labor and overhead. Costs incurred after the splitoff point are **separable costs**, and they are allocated to each product as they are incurred by that product.

There are a number of different allocation measures to use, but all of these different methods use some sort of ratio between the two or more products to allocate the joint costs. This is largely a mathematical exercise, but you need to remember how the different allocation bases are calculated. The different methods and how to calculate the bases follow.

Physical-unit Method

In this method joint-costs are allocated based on the actual number of units of each of the products produced. In addition to using the physical number of units, this allocation may be done based on the **weight, volume or other physical measure** of the joint products.

Relative Sales Value at Splitoff Method (or Gross Market Value Method)

Joint costs are allocated on the basis of the sales values of each product at the splitoff point, relative to the total sales value of all the joint products.

The formula to allocate the costs between or among the products is as follows:

$$\frac{\text{Sales Value of Product X}}{\text{Total Sales Value of all Joint Products}} \times \text{Joint Costs} = \text{Amount allocated to the individual Joint Product}$$

Estimated Net Realizable Value (NRV) Method

This method can be used if one or more of the joint products must be processed beyond the splitoff point in order to be sold, or if one or more of the joint products may be processed beyond the splitoff point in order to increase its value above the selling price at the splitoff point. This method is essentially the same as the relative sales value method, and the allocation is done in the same way, except an **estimated net realizable value (NRV)** is used for the product or products that will be processed further.

The estimated NRV for a product to be processed further is calculated as:

$$\begin{aligned} & \text{Sales price of items produced that will be sold in the future} \\ & - \text{Separable costs that are incurred after the splitoff point} \\ & = \text{Estimated Net Realizable Value} \end{aligned}$$

Note: If **one of the two products is not processed further**, but can be sold at the splitoff point, instead of using NRV, the company will use the relative sales values at the splitoff point for the product or products that can be sold at the splitoff point.

The estimated NRV method would generally be used instead of the sales value at splitoff point method **only** when a market price at the splitoff point is not available, for example, because a product is not marketable at the splitoff point.

If a sales value at splitoff is not available for both or all of the joint products, it is acceptable to use in the same allocation the net realizable value of a product that must be processed further in order to be sellable while using the sales value at splitoff for another product that can and will be sold at the splitoff point. For instance, you may have one product that **cannot** be sold at the splitoff point and must be processed further (thus there is no sales value at splitoff available for it), while the other product **can** be sold at the splitoff point. In a case such as this, the NRV of the product to be processed further is its **estimated NRV** (sales price after further processing less cost to process further), while the NRV of the product that can be sold at the splitoff point is its **sales value at the splitoff point**.

Note: The joint costs of production are not relevant costs in the decision to process further or sell immediately. This is because they are sunk costs. In order to determine if a product should be processed further, the company should compare the **incremental revenues** (the increase in the sales price that results from further processing) with the **incremental cost** (the increase in costs related to the additional processing).

Costs that are incurred by each of the products **after** the splitoff point are simply allocated directly to those products.

Constant Gross-Margin Percentage NRV

This method allocates the joint costs so that all of the joint products will have the same gross margin percentage. It is done by "backing into" the amount of joint cost to be allocated to each of the joint products.

Step 1: Calculate the gross margin percentage for the total of both (or all, if more than two) of the joint products to be included in the allocation by subtracting the total joint and total separable costs from the total final sales value and dividing the remainder by the total final sales value. This is done for all of the joint products **produced** during the period, not for all of the joint products **sold** during the period.

Step 2: Calculate the gross profit for each of the individual products by multiplying the total gross margin percentage calculated in Step 1 by each individual product's final sales value.

Step 3: Subtract the gross profit calculated in Step 2 and any separable costs from each individual product's final sales value. The result of this subtraction process will be the amount of joint costs to allocate to each product.

Example: Let us assume that Pineapple Co. produces pineapple juice and canned slices at its Pineapple Processing Plant in Hawaii. The information about the process and the two joint products are as follows:

- 10,000 pineapples are processed.
- The process results in 2,500 kg of juice and 7,500 kg of slices.
- The juice can be sold for \$10 per kg and the slices can be sold for \$15 per kg.
- The joint costs of production are \$120,000.
- The juice can be processed further into a premium juice. This will cost an additional \$8,000, but the sales price per kg will be \$15.
- The slices can be further processed into chunks. This will cost \$4,000 and the chunks can be sold for \$2 per kg more than the slices.

Let us calculate the amount of costs to allocate under the physical-unit method, the relative sales value at splitoff method, the net realizable value method and the constant gross-margin percentage NRV method:

Physical-unit method

Under this method the joint costs will be allocated based on the weight. Since the juice represents 25% of the total weight of the products, the juice will be allocated \$30,000 and the slices will be allocated \$90,000 of the joint costs.

Relative sales value at splitoff method

Using this method we will determine the total sales value of the juice ($2,500 \times \$10 = \$25,000$) and the slices ($7,500 \times \$15 = \$112,500$). The total sales value of the two products is \$137,500. Of this, the slices make up 81.8% ($\$112,500 \div \$137,500$), so the slices will be allocated \$98,182 of the joint costs and the juice will be allocated \$21,818.

Net realizable value method

In the NRV method we will need to calculate the net realizable value after the further processing of the two goods. The juice will incur \$8,000 in further costs, and will be sold for \$15 per kg, or \$37,500 in total. Thus the NRV of the juice is \$29,500. The slices will be processed further at a cost of \$4,000 and the sales value will be \$127,500. The NRV of the slices is \$123,500. In total, the NRV of the two products is \$153,000. Of this, the slices are 80.7% ($\$123,500 \div \$153,000$), so \$96,864 of the joint costs will be allocated to the slices. The remaining \$23,136 of the joint costs will be allocated to the juice.

Constant Gross-Margin Percentage NRV

We will set up partial income statements for each of the two joint products and their total, assuming that the additional \$8,000 in separable costs is spent for the juice to convert it to premium juice:

	<u>Premium Juice</u>	<u>Slices</u>	<u>Total</u>	<u>Gross Margin</u>
Final sales value	\$37,500	\$112,500	\$150,000	
Separable costs	8,000	--	8,000	
Joint costs	?	?	<u>120,000</u>	
Gross profit	<u>5,500</u> ²	<u>16,500</u> ³	\$ 22,000	14.6667% ¹
Joint cost allocated	<u>\$ 24,000</u> ⁴	<u>\$ 96,000</u> ⁵		

¹ $\$22,000 \div \$150,000$

² $\$37,500 \times .146667$

³ $\$112,500 \times .146667$

⁴ $\$37,500 - 8,000 - 5,500$

⁵ $\$112,500 - 16,500$

As you can see, the different methods all give similar allocations. However, they are different from each other and as such, the decision that the company makes as to the allocation method is an important one.

Byproducts

Byproducts are the low-value products that occur naturally in the process of producing higher value products. They are, in a sense, accidental results of the production process. The main issue for accounting for byproducts relates to the treatment of the costs and revenues associated with these byproducts.

There are two methods of accounting for byproducts that you need to be familiar with.

The Production Method: Inventory the Byproduct Costs (Byproduct Recognized at Production)

In the Production Method, the costs that are allocated to the byproducts are inventoried, and the sales revenue received from the sale of the byproduct is treated as a **reduction of the costs of production of the main product**.

Byproducts are inventoried in a separate inventory account at their estimated net realizable value. Inventoried costs allocated to the main product or joint products are reduced by the NRV allocated to the byproduct. When the byproduct is sold, the company recognizes no revenue or cost of goods sold but simply debits cash or accounts receivable and credits Byproduct Inventory.

And when the main product or joint products are sold, the COGS for the main product or joint products is lower because their inventory cost has been decreased by the NRV of the byproduct.

The reason it is done this way is because the NRV of the byproduct was used to determine its cost in inventory. Therefore, its cost will be the same as the revenue received for it, and there will be no gross profit on the sale. There would be no reason to record the sale of the byproduct by increasing revenue and COGS by the same amount, since the transactions would have no effect on net income. So the journal entry is simply the debit to cash or accounts receivable and the credit to byproduct inventory.

Note: Only the **sales proceeds from what can actually be sold** are used to reduce the costs of production of the main product. If some of the byproduct cannot be sold, it is not included.

The Sales Method: Revenue from the Byproduct (Byproduct Recognized at Time of Sale)

In the Sales Method, the byproduct costs are not put into inventory separately from the main product or joint products. Instead, all of the costs of production are allocated to the main product or joint products in inventory. When the main product or joint products are sold, their COGS will be higher than it would have been under the Production Method. Since the byproduct is not put into inventory at all, when it is sold the sale is recorded the way service revenue would be recorded, with no associated COGS. So the company debits cash or accounts receivable and credits revenue for the amount of the sale.

Which Method Is Better?

Both methods are acceptable. The Production Method, where the byproduct is inventoried at the time of production is conceptually correct because it is consistent with the matching principle. Byproduct inventory is recognized as an asset in the accounting period in which it is produced, and it reduces the inventory cost assigned to the main product or joint products.

However, the Sales Method, where the byproduct is recognized at the time of sale, is simpler and is used more frequently in practice if the dollar amounts of the byproduct(s) are immaterial. There is a disadvantage to the sales method, though. The sales method makes it possible for managers to time when they sell the byproduct(s) and thus permits them to manage their earnings. A manager could store the byproducts for a period of time and sell them to increase revenues and profits during a time when sales and/or profits from the main product or joint products are low.

Note: A question on the Exam will outline the treatment of the costs or revenue associated with the byproduct and you just need to follow the math that is required. **If the question states that the company inventories the byproduct, this means that it treats the revenue as a reduction of the costs of production;** this is the first method above.

Question 112: Sonimad Sawmill manufactures two lumber products from a joint milling process. The two products developed are mine support braces (MSB) and unseasoned commercial building lumber (CBL). A standard production run incurs joint costs of \$300,000 and results in 60,000 units of MSB and 90,000 units of CBL. Each MSB sells for \$2 per unit, and each CBL sells for \$4 per unit.

If there are no further processing costs incurred after the splitoff point, the amount of joint cost allocated to the mine support braces (MSB) on a relative sales value basis would be:

- a) \$75,000
- b) \$180,000
- c) \$225,000
- d) \$120,000

(CMA Adapted)

Question 113: A company manufactures products X and Y using a joint process. The joint processing costs are \$10,000. Products X and Y can be sold at splitoff for \$12,000 and \$8,000, respectively. After splitoff, product X is processed further at a cost of \$5,000 and sold for \$21,000, whereas product Y is sold without further processing. If the company uses the relative sales value method for allocating joint costs, the joint cost allocated to X is:

- a) \$5,000
- b) \$6,000
- c) \$6,667
- d) \$10,000

(CIA Adapted)

Question 114: A company processes a raw material into products F1, F2, and F3. Each ton of raw material produces 5 units of F1, two units of F2, and 3 units of F3. Joint-processing costs to the splitoff point are \$15 per ton. Further processing results in the following per-unit figures:

	<u>F1</u>	<u>F2</u>	<u>F3</u>
Additional processing costs per unit	\$28	\$30	\$25
Selling price per unit	\$30	\$35	\$35

If joint costs are allocated based on the net realizable value of finished product, what proportion of joint costs should be allocated to F1?

- a) 20%
- b) 30%
- c) 33 1/3%
- d) 50%

(CIA Adapted)

Question 115: Lankin Corp. produces two main products and a byproduct out of a joint process. The ratio of output quantities to input quantities of direct materials used in the joint process remains consistent from month-to-month. Lankin has employed the physical-volume method to allocate joint production costs to the two main products. The net realizable value of the byproduct is used to reduce the joint production costs before the joint costs are allocated to the two main products. Data regarding Lankin's operations for the current month are presented in the chart below. During the month, Lankin incurred joint production costs of \$2,520,000. The main products are not marketable at the splitoff point and, thus, have to be processed further.

	<u>1st Main Product</u>	<u>2nd Main Product</u>	<u>Byproduct</u>
Monthly input in pounds	90,000	150,000	60,000
Selling price per pound	\$30	\$14	\$2
Separable process costs	\$540,000	\$660,000	

The amount of joint production cost that Lankin would allocate to the Second Main Product by using the physical-volume method to allocate joint production costs would be:

- a) \$1,200,000
- b) \$1,260,000
- c) \$1,500,000
- d) \$1,575,000.

(CMA Adapted)

Process Costing

Process costing is the method in which costs are assigned to individual products when the products are all relatively similar (the term "homogeneous" means identical to each other) and are mass-produced. This is basically applicable to **assembly lines** and anything that shares a similar production process. In process costing all of the costs incurred by a process (a process is often referred to as a department) are collected and then allocated to the individual goods that were produced, or worked on, during that period within that process (or department).

The basic exercise is to allocate all of the incurred costs to either the finished goods that left the department or to the ending work-in-process (EWIP) that is still in the department. It is largely a mathematical operation and as we will see, there are some basic formulas that we can use to make certain that everything is accounted for.

We will start by looking at some general concepts and ideas of process costing and will then go through the steps of process costing one-by-one. We will conclude the coverage of process costing by reviewing the steps and studying a comprehensive example.

As already briefly mentioned, all of the costs incurred in a department during a period must be allocated to either finished goods or EWIP at the end of that period.

The costs in the department that require allocation can come from one of three places:

- 1) They are **incurred by the department** during the period (such as labor),
- 2) They are **transferred in** from the previous department, or
- 3) They were in the department on the first day of the period in the form of **beginning work-in-progress (BWIP)**.

In reality the categories of costs can be numerous. There may be direct materials, direct labor, indirect materials, indirect labor or other overheads. However, on the CMA Exam, there are generally only two classifications of costs – **materials and conversion costs**. Conversion costs include everything other than materials and are the costs necessary for converting the raw materials into the finished product.

Note: Conversion costs is a term that is used in process costing questions to refer to **direct labor** and **factory overhead**. It encompasses everything except raw materials. Conversion costs are the costs necessary to convert the raw materials into the finished product. Placing these different costs into one category simply reduces the number of individual allocations that you need to make on a question.

Note: Transferred-in costs are the total costs that come with the new product from the previous department. They are similar to Raw Materials but in reality will include all of the costs (material and conversion costs) from the previous department. The previous department's "finished goods" are this department's transferred-in costs and the costs for both of these items should be the same.

As we have said, at the end of the period all of the costs within the department must either be moved to Finished Goods Inventory or they will remain in Ending WIP (we will look at this allocation process later). The Ending WIP from this period will be the Beginning WIP for the next period. If the goods are then sold before the end of the period, the costs associated with the units that were sold will end up in COGS. The costs of the units that have not been sold will be in Ending Inventory – Finished Goods.

This means that the cost of every unit that goes through a particular process in a given period must be recorded in either:

- 1) Ending WIP in the process,
- 2) Ending finished goods inventory, or
- 3) Cost of goods sold.

Items 2 and 3 above are also classified together as **transferred out** of the department. This simply means that the unit has been finished in this process and transferred to the next department (or finished goods). Whether it has been sold (and is in COGS), still being worked on (ending WIP for the company), or finished but not sold (ending finished goods inventory for the company) is irrelevant to what we are looking at here.

Note: The basic accounting for this type of system is as follows: all of the costs incurred are **put into a WIP account**. These costs include **direct material** (though direct materials are usually allocated differently from the conversion costs and may be accounted for separately), **direct labor, indirect materials, indirect labor** and **factory overhead**. These costs that are in WIP then need to be transferred to either finished goods or ending WIP at the end of the period. This will be done based on a per unit allocation basis, in a manner similar to the standard allocation of overhead. However, you do not need to be familiar with the accounting steps in this process, just the allocation process. This information is presented because it may help you see what is happening in this process.

Steps in Process Costing

We will now examine the steps in process costing in more detail. It is important that you are very comfortable with **equivalent units of production** (covered in much more detail later) and how they are calculated. This is an important part of process costing and one that is likely to be tested. The steps in process costing are:

- 1) Determine the physical flow of goods,
- 2) Calculate how many units were started and completed during the period,
- 3) Determine when materials are added to the process,
- 4) Calculate the equivalent units of production for materials and conversion costs,
- 5) Calculate the costs incurred during the period for materials and conversion costs,
- 6) Calculate the cost per equivalent unit for materials and conversion costs, and
- 7) Allocate the costs for materials and conversion costs separately between EWIP and Transferred Out according to the equivalent units in each.

Each step is looked at in more detail below.

1. Determine the Physical Flow of Goods

One of the most important things that you may need to do in a process costing problem is to track each of the physical units that go through the department and know where they came from and where they were at the end of the period. In a problem you will be given enough information to solve this type of situation if you understand the way the goods move. The formula below enables you to do this for **physical units**:

$$\text{Units in Beginning WIP} + \text{Units Transferred In}^{\circ} = \text{Units in Ending WIP} + \text{Units Completed}$$

You must be able to use this formula to solve for any of the items within it.

Note: When doing a problem like this about physical flow, the completion percentages for any of the beginning or ending WIP units are not important (this is part of equivalent units of production that we will look at later). Here, we are looking simply at the number of physical units.

^o In a problem, this may also be the number of units started during the period if the process is the first in the assembly line.

Question 116: Ben Company had 4,000 units in its work-in-process (WIP) on January 1. Each unit was 50% complete in respect to conversion costs. During the first quarter, 15,000 units were completed. On March 31, there were 5,000 units in ending WIP that were 70% complete in respect to conversion cost. For this product, all of the direct materials are added when the unit enters the facility. How many units did Ben start during the first quarter?

- a) 13,000
- b) 15,000
- c) 16,000
- d) 16,500

(HOCK)

2. Calculate the Number of Units Started and Completed

Another similar formula, which enables us to calculate the number of units that were started and completed (meaning that 100% of the work was performed this period), is as follows:

$$\# \text{ Units Completed} - \# \text{ in Beginning WIP} = \text{Units Started and Completed This Period}$$

3. Determine When the Materials Are Added to the Process

This is actually a very simple thing to do, because this information will be provided in the question. However, this is an important item for later steps so it is important that you identify if the materials are added at the beginning of the process, the end, at some point in the middle or evenly throughout. Usually, conversion costs are added evenly throughout the process, so that is not a concern for us.

4. Calculate the Equivalent Units of Production (EUP)

To allocate costs to the individual units produced, we need to know how many units the costs should be allocated to. In a system where there is no beginning or ending WIP in the department, this allocation of costs would be a simple matter of dividing the costs by the number of units that were produced during the period.

However, since we have beginning and ending WIP, the process is more complicated. We accomplish this allocation by calculating the number of units that would have been 'completely produced' (100% completed) during the period if the company had simply produced one unit from start to finish, and then started another unit. "Completely produced" means completed from start to finish with all direct materials added and all conversion cost activities completed. This number of complete units that could have been completed during the period is called the number of **equivalent units of production**.

By way of illustration, because the units in beginning WIP are already completed to some extent, we don't have to do one full unit's worth of work in order to finish each unit that is in BWIP. Similarly, because each unit that is in ending WIP is not entirely complete, we have done less work on each of these items than on the complete units. We must determine how many equivalent units were produced (EUP) during the period.

Essentially, there are three different amounts of work that may apply to an individual unit during the period:

- 1) **Completed**, meaning that some of the work was done in the previous period,
- 2) **Started and Completed^P**, meaning that the unit was transferred in and completely finished in this period, or
- 3) **Started**, meaning that these are units that were transferred in during the period, but were not finished and have not yet been transferred out of the process.

^P Remember that the formula for started and completed is: Units Completed – Units in BWIP.

The idea of EUP is probably best explained with a couple of examples.

Example: If there are 100 units in beginning WIP and each unit is 25% complete, if there are no other units added to the system this period, and at the end of the period there are 100 complete units, the number of EU produced this period is 75. This was calculated as $100 \times .75$, since 100 units needed 75% of the work in order to complete them.

Example: Let us assume that in addition to the 100 units in beginning WIP (still 25% complete), there were also 100 units transferred in during the period, and at the end of the period there are 10 units in ending WIP that are 40% complete. Calculate the number of units completed and the number of EU completed during the period.

The number of units completed is 190. This is calculated using the formula: Units in BWIP (100) + Units transferred in (100) = Units in EWIP (10) + Units Completed (must be 190). Having calculated the number of units completed, we can now determine that there were 90 units started and completed (190 units completed – 100 units in BWIP). To calculate the EUP we need to use the three steps of what could be done to a unit during the period.

The calculation of equivalent units of production is:

To Complete BWIP ($100 \times .75$) =	75
Started and Completed (90×1) =	90
To Start EWIP ($10 \times .4$) =	<u>4</u>
Total EUP	<u>169</u>

Though this concept of EUP is mathematically simple, people sometimes initially have trouble with it. So please make certain that you spend the necessary time and are comfortable with how it works. We will look at it in the following pages.

Question 117: Ben Company operates a production facility that has three departments. The following information is in respect to the second production department for the month of May:

Number of units in BWIP	200
% complete for BWIP	20%
Number of units started	1,300
Number of units completed	1,100
Number of units in EWIP	400
% complete for EWIP	80%

The equivalent units of production for Ben Company for May was:

- a) 900
- b) 1,260
- c) 1,380
- d) 1,620

(HOCK)

EUP for Materials and Conversion Costs Separately

There is, unfortunately, another minor complication to this process, which is that in the problem we will probably need to calculate EUP for materials and conversion costs separately. This does not make the problem any more difficult; it simply means that we have more calculations to complete. This allocation may be different because materials and conversion costs may be added in different rates for the same product. In many products all of the materials are added at the very beginning of the process and it is only the conversion costs that are added throughout the process.

When the Materials Are Added

In EUP questions you must also pay attention to when materials are added to the process. In a situation in which the materials are added when the unit is 50% complete as to conversion costs, and the ending WIP is only 40% completed as to conversion costs, the materials have not yet been added to the units in ending WIP and therefore are not included in the EUP of materials. However, if the units in ending WIP were 60% complete for conversion costs, this would mean that the entire unit of material has been added. In this case, the unit would be 100% complete for materials, but only 60% complete for conversion costs.

This is something that you will need to pay attention to, and it is included in some of the questions in the materials.

Question 118: Hoepfner Corp. uses process costing to allocate costs. In the Pressing Department all of the materials are added at the very beginning of the process. After this first addition, no additional materials are added during the process. At the end of January, Hoepfner was presented with the following information:

Beginning Work-in-Progress (60% complete for conversion costs)	2,000
Units started in January	5,000
Transferred out from Pressing during January	6,000
Ending Work-in-Progress, (40% complete for conversion costs)	1,000

Under the EUP method already discussed, what are the equivalent units of production for the month of January?

	<u>Materials</u>	<u>Conversion</u>
a)	5,000	5,200
b)	5,000	5,600
c)	5,200	5,400
d)	5,200	5,200

(HOCK)

EUP and Inventory Tracking Methods

Another complication in the EUP calculation and the allocation of costs (and a much more significant complication) is that the determination of EUP is influenced by the inventory method that the company uses in its process costing. As with regular inventory, we need a system to determine if the unit that was completed was an old unit taken from the units that were in BWIP, or not. In process costing, there are two inventory flow systems that are used:

- 1) **First-in-first-out (FIFO)** – In FIFO we assume that in each period we finish what is in BWIP before starting any new units (this is what has been used in the previous explanations and examples), and
- 2) **Weighted Average (WAVG)** – In WAVG we do not assume that the units in BWIP are finished first and as a result, all of the units (from BWIP and transferred in this period) will be treated the same. The costs of beginning WIP and the work done during the current period will be averaged.

The main difference between these two methods is the **treatment of the costs that were assigned in the last period to the units in BWIP**. Very briefly (this is covered in much more detail later), under FIFO the costs of BWIP go to finished goods (or transferred out) and under WAVG the costs in BWIP will be combined with the costs of the current period to calculate a weighted average.

You need to be able to make the calculations for EUP under both of these methods. They are discussed in more detail individually below. There is a simple formula for each method for calculating EUP. If you memorize this formula, you should be able to answer EUP questions.

EUP Under FIFO Method

Under the FIFO assumption we assume that all of the units that were in BWIP at the start of the period were completed before any other new units were started. This means that under the FIFO method, we know for certain that all of the units that were in BWIP are now in finished goods (or were transferred out of the department) at the end of the period.

Because we know that the units that were in BWIP have been transferred out of the department, the costs that were already associated with those units in BWIP are kept separate from the costs that are incurred during the current period. Those costs that were in BWIP at the start of the period are transferred directly to finished goods.

This means that the calculation of EUP and the allocation of the costs to the units produced will include only the **work actually done during the period and the costs incurred this period**. In other words, the cost per EUP calculation will include three elements: 1) the work required to finish the units in BWIP; 2) the work for all of the units started and completed; and 3) the work done to start the EWIP. Those costs and EUP that are already in BWIP will automatically be transferred to Finished Goods because under the FIFO assumption we assume that first the units in BWIP are finished, and then other new units are started.

Note: When the units are transferred out, the costs incurred this period, as well as the costs that were with BWIP, are combined as the transferred-in costs for the next department – they are not kept separate in future departments. This means that the next department will use a weighted average for the cost of the units transferred in and will not have similar units that have different costs.

The FIFO calculation of EUP during the period is as follows (you **must** know this):

How Calculated	
Completion of BWIP	Units in BWIP × % of work done this period
+ Started & Completed	# of S&C Units × 1
+ Starting of EWIP	#of units in EWIP × % of work done this period
= EUP this period	TOTAL

EUP Under the Weighted Average Method

In this method we assume that all of the costs and EUP that are in BWIP are simply added together with all of the work that is done this period and averaged together. We draw **no distinction between the units that were in BWIP and the units that were transferred in** during the period. This means that we will not make any distinction between the work done (and costs incurred) on the BWIP last period and the costs incurred and work done this period to finish the BWIP.

The costs that are associated with BWIP are combined with the costs that were incurred during the current period. This means that we will consider all of the units that were in BWIP to have been 100% worked on and completed **during the current period**. This will enable us to reassign the total combined cost to all units worked and determine their average cost.

Again, in WAVG, the costs and EUP of work that already were held in BWIP at the start of the period are considered to have been incurred and worked during this current period. Therefore, we are calculating an average cost for the work done last period that is still in the department as well as the costs incurred this period.

Because we are assuming that all of the work done on BWIP was done during this period, the calculation of EUP for the weighted average method is simpler than for FIFO. For WAVG there are only two categories of units for which we need to calculate EUP. These two categories are Units Completed and the starting of EWIP.

The formula for EUP under the WAVG Method is as follows (you **must** know this):

	<u>How Calculated</u>
Units Completed⁹	# of Units completed during the period × 1
+ Starting of EWIP	#of units in EWIP × % of work done this period
= EUP this period	TOTAL

This method essentially creates a weighted average cost of the production costs of the two periods by putting them together (and hence, the name).

Note: The **EUP under the weighted average method can never be lower than under FIFO**. They will be equal if there was no BWIP, but FIFO can never be higher than the weighted average method. The difference in the EUP between the two methods will be equal to the EUP that were in BWIP at the start of the period.

⁹ Units completed is calculated as: Units in BWIP + Transferred In – Units in EWIP = Units Completed

The following information is for the next four Questions: Levittown Company employs a process cost system for its manufacturing operations. All direct materials are added at the beginning of the process, and conversion costs are added proportionately. Levittown's production schedule for November is:

	<u>Units</u>
Work-in-process on November 1 (60% complete as to conversion costs)	1,000
Units started during November	<u>5,000</u>
Total units to account for	<u>6,000</u>
Units completed and transferred out from BI	1,000
Units started and completed during November	3,000
Work-in-process on November 30 (20% complete as to conversion costs)	<u>2,000</u>
Total units accounted for	<u>6,000</u>

Question 119: Using FIFO, the EUP for direct materials for November are:

- a) 5,000 units
- b) 6,000 units
- c) 4,400 units
- d) 3,800 units

Question 120: Using FIFO, the EUP of conversion costs for November are:

- a) 3,400 units
- b) 3,800 units
- c) 4,000 units
- d) 4,400 units

Question 121: Using weighted-average, the EUP for materials for November are:

- a) 3,400 units
- b) 4,400 units
- c) 5,000 units
- d) 6,000 units

Question 122: Using weighted-average, the EUP for conversion costs for November are:

- a) 3,400 units
- b) 3,800 units
- c) 4,000 units
- d) 4,400 units

(CMA Adapted)

5. Calculation of Costs Incurred During the Period

After calculating the EUP during the period the next step is to look at the calculation of the costs that were incurred during the period. This is affected by the inventory method that is used in much the same way as the calculation of EUP was affected. FIFO and WAVG allocate the costs differently, but you must remember that the difference relates only to the costs that are in the BWIP. All other costs are handled in the same way in both methods.

Costs Incurred Under the FIFO Method

Under the FIFO method all of the costs that are in BWIP are transferred directly to finished goods. This is because under FIFO, we assume that the units in BWIP are all finished before other units are started. Therefore, all of the costs in BWIP will end up in finished goods this period. The only costs that will be allocated to the EUP are the costs that were actually incurred during this period.

Costs Incurred Under the Weighted Average Method

Under the weighted average method we will take all of the costs that are in BWIP and simply add them together with the costs that were actually incurred during this period. This is the same as we did with the calculation of EUP under the weighted average method. This 'total cost' will be allocated to the EUP that was calculated under the WAVG method.

Because of mixing the costs of the current and previous periods, we get the weighted average.

Selecting an Inventory Method

The weighted average method is simpler to use since there is only one calculation. However, this method mixes together costs, so any change in the cost of an input is in a sense covered up by the weighted average. **The weighted average method is best used when prices are stable.**

Because the FIFO method keeps the costs of the two periods separate, it is better to use **FIFO when there is a change in the price of the inputs between the two periods.**

6. Calculation of the Cost per EUP

Once the EUP has been determined (under either FIFO or WAVG), and the costs to be allocated have been identified, we must determine a rate (or unit cost) per EUP for both raw materials and conversion costs. This is done by dividing each of the total costs to be allocated (step #5) by the EUP for both materials and conversion costs (step #4). These rates for materials and conversion costs must be calculated separately because the EUP for both may be different.

Note: Remember that if using the FIFO basis, all of the costs associated with the BWIP are automatically transferred to FG and they do not need to be allocated to the EUP.

7. Allocation of the Costs to the Products

After the rates per EUP for materials and conversion costs have been determined, the last step is to allocate the costs to finished goods and to EWIP based upon the number of EUP that are in EWIP and FG. This is simply a mathematical exercise that requires multiplying the EUP by the rate (or cost) per EUP.

Note: It is usually easiest to allocate the costs to EWIP first and then all remaining costs end up in FG. In FIFO, however, it is critical that you do not forget to allocate the costs in BWIP to finished goods.

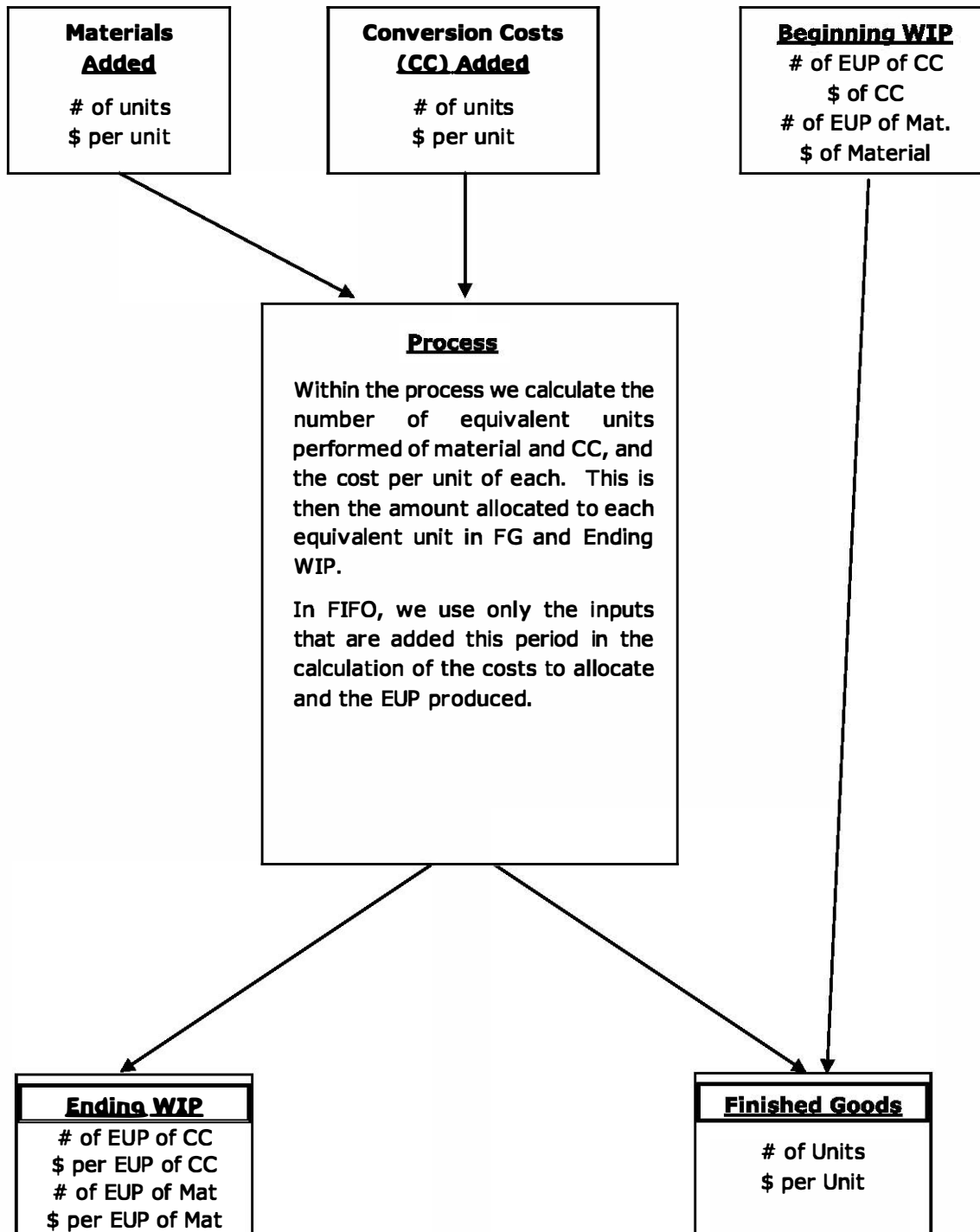
On the following two pages are diagrams illustrating the FIFO and Weighted Average process costing systems. Note that the only difference between them is the treatment of BWIP. Under FIFO, the costs of BWIP go directly to the finished goods, while under the weighted average method they are added into the "process" for

this period. Similarly, under the weighted average method the work that had been done in previous periods on the BWIP is also added to the "process" and is considered to have been done this period.

Following the diagrams, we will again go through the steps to process costing and this will be followed by an example that goes through all of these steps for both FIFO and WAVG.

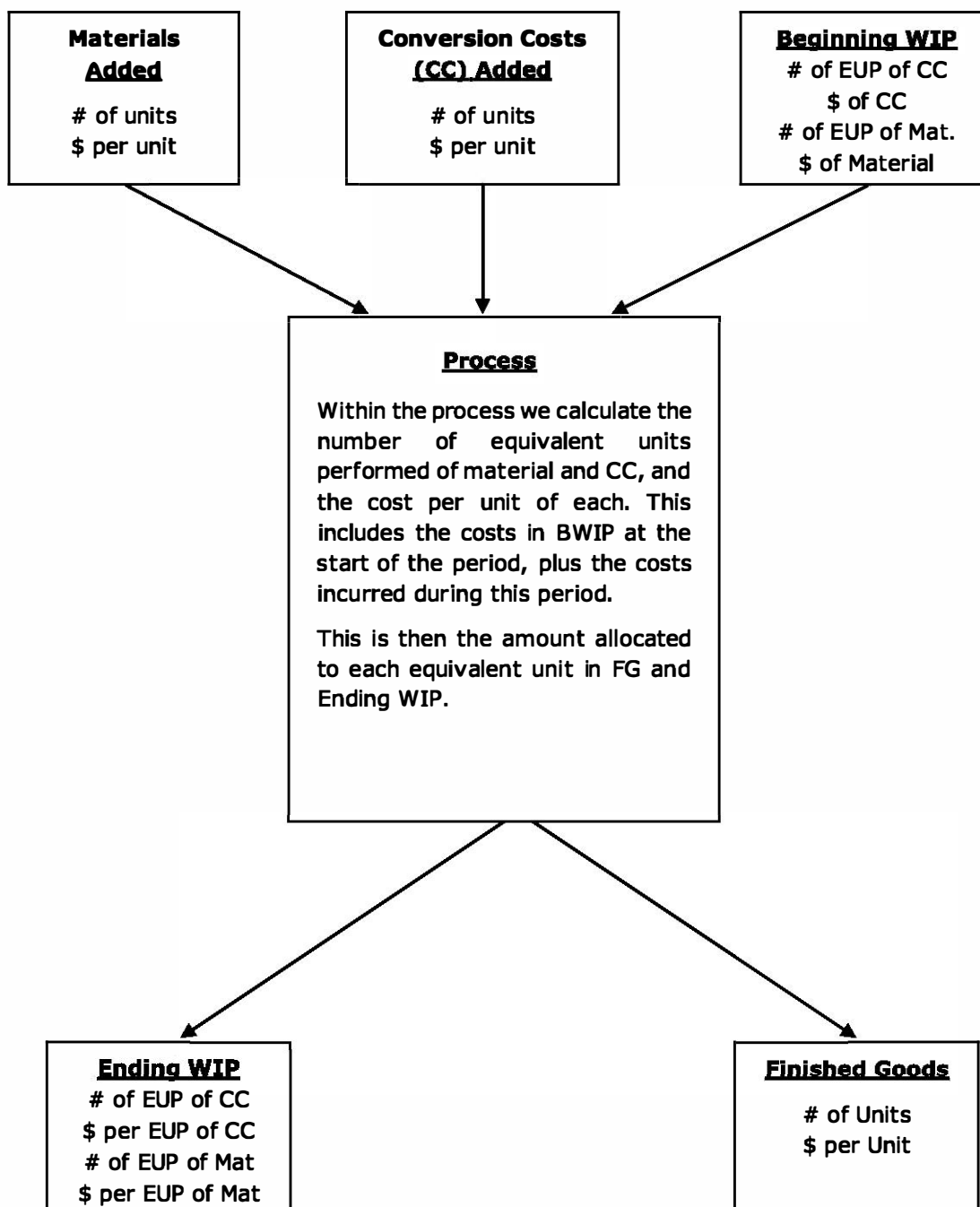
Process Costing Diagram – FIFO

In FIFO, the costs in Beginning WIP are automatically transferred to FG because we assume that the items in BWIP are completed before working on any new items. This is the critical part of the FIFO assumption.



Process Costing Diagram – Weighted Average

In the Weighted Average method we assume that all of the work that already exists in beginning WIP was done this period. This means that we are going to be averaging the costs of last month's and this month's work together. The amount of 'averaging' that occurs between the costs of the two periods will be significant only if there is a large amount of BWIP in the current period **and** if there are significant changes in price from one period to the next. If these two conditions do not exist, the weighted average method will give virtually the same cost allocations as the FIFO method.



Process Costing Summary

The method for solving process costing questions is something with which you will become very familiar very quickly, and hopefully it will become straightforward for you as well. Outlined below are the various steps in solving a process costing problem.

- 1) Determine the **physical flow of units of goods**. This calculation has nothing to do with equivalent units, but is simply the process of determining how many units there are to account for. The formula is:

$$\text{Units in BWIP} + \text{Transferred In} = \text{Units in EWIP} + \text{Transferred Out} + \text{Spoiled Units}^r$$

- 2) Calculate **how many units were started and completed** during the period. The formula is:

$$\text{Started and Completed} = \text{Units Transferred Out} - \text{Units in BWIP}$$

- 3) Determine when the materials are added to the process.
- 4) **Calculate the equivalent units of production** during the period. This calculation will most likely need to be done twice – once for materials and once for conversion costs. If materials are added at the beginning of the process (or at any other point in the process) you will need to make the EUP calculation separately. However, if the materials are also added evenly in the process, only one calculation for EUP for both materials and conversion costs must be made.

The manner in which this is done will depend on the method used by the company. Below are the two formulas for making this calculation.

For FIFO:

Completion of BWIP	Units in BWIP × % work done this period
+ Started and Completed^s	Number of S&C Units × 1
+ Starting of EWIP	Units in EWIP × % work done this period
= EUP this period	TOTAL

For Weighted Average:

Units Completed^t	Units completed during the period × 1
+ Starting of EWIP	Units in EWIP × % work done this period
= EUP this period	TOTAL

- 5) Calculate the **costs incurred during the period**. Again, this calculation will depend upon the method used. If the method is FIFO the only costs that will be included will be those actually incurred during the period.

If the method is the weighted average method the costs used will include those incurred during the period, plus the costs in BWIP.

The costs for materials and conversion costs need to be calculated separately.

- 6) **Calculate the cost per equivalent unit for materials and conversion costs**. We accomplish this by simply dividing the costs from Step 5 by the EUP calculated in Step 4.

^r These spoiled units may be normal, abnormal or some of both. Spoilage is covered later.

^s Started and Completed is calculated as Units Completed – Units in BWIP

^t Units completed is calculated as: Units in BWIP + Transferred In – Units in EWIP = Units completed

- 7) **Allocate the costs to EWIP and Finished Goods.** This is done by multiplying the EUP calculated in Step 4 by the cost per EUP that was calculated in Step 6. It is usually easiest to do this by calculating the ending inventory value since there is only one calculation. In order to calculate the finished goods amount, two calculations are needed.

Note: The answer to the comprehensive example provides a more complete illustration of this process with numbers.

Process Costing Examples

On the following two pages is an example of how this entire process works for both the FIFO and the Weighted Average methods. We will look at the same situation and calculate the dollar value of EWIP and FG using both the FIFO and Weighted Average methods. It is very unlikely that you will need to do this on the Exam (since it is multiple choice), but if you are able to understand the entire process, the Exam questions will be easier as they generally ask about only one part of the process.

Example: Beginning WIP inventory is 150 units (60% complete). Beginning WIP inventory material costs are \$250 and conversion costs are \$500.

All material for the product is added at the beginning of the production process. Conversion takes place continuously throughout the process. During the period 550 units were started. Material costs for the period are \$800 and conversion costs for the period are \$6,000.

Ending WIP is 80 units at 20% completion.

Calculate the amounts to be in EWIP and FG using the **FIFO method**.

1) Determine the physical flow.

BWIP	+	Started	=	EWIP	+	Finished Goods
150	+	550	=	80	+	620

2) Calculate the Started and Completed.

S&C	=	Transferred Out	-	BWIP
470	=	620	-	150

3) Materials are added at the beginning of the process.

4) Calculate equivalent units of production.

	<u>Materials</u>	<u>Conversion Cost</u>	
BWIP (excluded from EUP for FIFO)	150	90	
BWIP COMPLETED	0	60	= 150 × 40%
STARTED & COMPLETED	470	470	
EWIP	80	16	= 80 × 20%
TOTAL EUP	550	546	

5) Calculate costs incurred.

Materials	\$800
Conversion Costs	\$6,000

6) Costs per equivalent unit.

Materials	$\$800 \div 550 =$	\$1.46
Conversion Costs	$\$6,000 \div 546 =$	\$10.99

7) Allocate costs to EWIP.

Materials	$\$1.46 \times 80 =$	\$116.80
Conversion Costs	$\$10.99 \times 16 =$	\$175.84
Total		<u>\$292.64</u>

Allocate costs to finished goods.

Costs of BWIP	$\$250 + \$500 =$	\$750
Materials	$\$1.46 \times 470 =$	\$686.20
Conversion Costs	$\$10.99 \times 530 =$	\$5,824.70
Total		<u>\$7,260.90</u>

Example: Beginning WIP inventory is 150 units (60% complete). Beginning WIP inventory material costs are \$250 and conversion costs are \$500.

All material for the product is added at the beginning of the production process. Conversion takes place continuously throughout the process. During the period 550 units were started. Material costs for the period are \$800 and conversion costs for the period are \$6,000.

Ending WIP is 80 units at 20% completion.

Calculate the amounts to be in EWIP and FG using the **Weighted Average method**.

1) Determine the physical flow.

BWIP	+	Started	=	EWIP	+	Finished Goods
150	+	550	=	80	+	620

2) Calculate the Started and Completed.

S&C	=	Transferred Out	-	BWIP
470	=	620	-	150

3) Materials are added at the beginning of the process.

4) Calculate equivalent units of production.

	Materials	Conversion Cost	
BWIP (included in EUP for Wtd Avg)	150	90	= 150 × 60%
BWIP Completed	0	60	= 150 × 40%
STARTED & COMPLETED	470	470	
EWIP	<u>80</u>	<u>16</u>	= 80 × 20%
TOTAL	700	636	

5) Calculate costs incurred.

Materials	\$250 + \$ 800 =	\$1,050
Conversion Costs	\$ 500 + \$ 6,000 =	\$6,500

6) Costs per equivalent unit (including costs in BWIP).

Materials	$(\$250 + \$800) \div 700 =$	\$1.50
Conversion Costs	$(\$500 + \$6,000) \div 636 =$	\$10.22

7) Allocate costs to EWIP.

Materials	$\$1.50 \times 80 =$	\$120.00
Conversion Costs	$\$10.22 \times 16 =$	\$163.52
Total		<u>\$ 283.52</u>

Allocate costs to finished goods.

Materials	$\$1.50 \times 620 =$	\$930.00
Conversion Costs	$\$10.22 \times 620 =$	\$6,336.40
Total		<u>\$7,266.40</u>

The following information is for the next two Questions: A sporting goods manufacturer buys wood as a direct material for baseball bats. The Forming Department processes the baseball bats, which are then transferred to the Finishing Department where a sealant is applied. The Forming Department began manufacturing 10,000 "Casey Sluggers" during the month of May. There was no beginning inventory.

Costs for the Forming Department for the month of May were as follows:

Direct materials	\$33,000
Conversion costs	<u>17,000</u>
Total	<u>\$50,000</u>

A total of 8,000 bats were completed and transferred to the Finishing Department; the remaining 2,000 bats were still in the forming process at the end of the month. All of the Forming Department's direct materials were placed in process, but, on average, only 25% of the conversion cost was applied to the ending work-in-process inventory.

Question 123: The cost of the units transferred to the Finishing Department is:

- a) \$50,000
- b) \$40,000
- c) \$53,000
- d) \$42,400

Question 124: The cost of the work-in-process inventory in the Forming Department at the end of May is:

- a) \$10,000
- b) \$2,500
- c) \$20,000
- d) \$7,600

(CMA Adapted)

The following information is for the next two Questions: Kimbeth Manufacturing uses a process cost system to manufacture Dust Density Sensors for the mining industry. The following information pertains to operations for the month of May.

	<u>Units</u>
Beginning work-in-process inventory, May 1	16,000
Started in production during May	100,000
Completed production during May	92,000
Ending work-in-process inventory, May 31	24,000

The beginning inventory was 60% complete for materials and 20% complete for conversion costs. The ending inventory was 90% complete for materials and 40% complete for conversion costs.

Costs pertaining to the month of May are as follows:

- Beginning inventory costs are materials, \$54,560; direct labor, \$20,320; and factory overhead, \$15,240.
- Costs incurred during May are materials used, \$468,000; direct labor, \$182,880; and factory overhead, \$391,160.

Question 125: Using the weighted-average method, the equivalent unit cost of materials for May is

- a) \$4.12
- b) \$4.50
- c) \$4.60
- d) \$5.02

Question 126: Using the weighted-average method, the equivalent unit conversion cost for May is

- a) \$5.65
- b) \$5.83
- c) \$6.00
- d) \$6.20

(CMA Adapted)

Spoilage in Process Costing

Spoilage is the term used for defective units that are **not transferred** to the next process. When there is spoilage, some of the costs of production will be allocated to the spoiled units. These spoiled units become an additional step in the calculation of EUP because they did have some work done on them prior to becoming spoiled.

This is similar to treating spoilage as another form of ending WIP – the units were started, but never finished. It is also possible that they were finished but were designated as spoiled when inspection took place at the end of the process. But fundamentally, the spoiled units are more like EWIP because they are not transferred to the next department. The spoiled units will also receive the cost per EUP. We will look at this treatment of the costs later.

As covered earlier, all of the costs that are in the department (either as Beginning WIP or incurred during the period) must be moved out of the department at the end of the period to either finished goods (FG) or Ending WIP. However, now that we add spoilage to the situation, there is another possible treatment for costs that are incurred in the process during the period.

If there are spoiled units in the process, we must allocate the material costs and conversion costs to these spoiled units. The amount that will be allocated is done through the EUP and will depend on when the unit is identified as spoiled.

EUP for Spoilage for Conversion Costs

If the units are inspected at the end of the process, each spoiled unit will represent one complete EUP and will receive the same costs as a good unit produced during the period. If, however, the inspection is made at the halfway point (or any other point) in the process, then the spoiled units will have only one half (or the applicable % based on when the inspection takes place) of an EUP for conversion costs.

EUP for Spoilage for Materials

The EUP for materials will depend on when the materials are added to the process.

Allocation of Costs to the Spoiled Units

After the cost per EUP of materials and conversion costs are calculated as discussed above, the company will allocate costs to each unit, including the spoiled units. This is done in the same manner as the allocation to EWIP – the number of EUP for spoiled units is multiplied by the cost per EUP. Again, this will probably be done separately for materials and conversion costs.

Transferring the Costs of Spoiled Units

After determining the costs of the spoiled units, they must be transferred somewhere at the end of the period. (These costs will be some amount of materials and conversion costs.) It is obvious that these units are neither finished goods nor work-in-process, but the costs have been incurred in the department and must be moved out of the department.

The treatment of spoilage costs will depend on the type of spoilage. Spoilage is classified as either normal spoilage or abnormal spoilage. Normal spoilage is the level and amount of spoilage that normally occurs during the process, and abnormal spoilage is any spoilage in excess of this normal expected amount of spoilage.

Note: The amount of spoilage that is considered normal will be given to you in the question.

Normal Spoilage

If the spoilage is **normal spoilage**, the costs that have been allocated to the normally spoiled units are added to the costs of the good units that are **transferred to finished goods** (or the next department). This will cause the cost per unit transferred in to the next department to be higher than the cost of producing a good unit in the current department.

Abnormal Spoilage

Abnormal spoilage is all spoilage in excess of the normal level of spoilage. The costs that have been allocated to the abnormal spoiled units will be **expensed on the income statement** in that period as a **loss from abnormal spoilage**.

It is generally considered that production management can control abnormal spoilage because normal spoilage is expected to occur and generally cannot be prevented. However, abnormal spoilage, by definition, should not occur and should therefore be preventable.

Note: When there is more than one point at which inspection of goods is made, the costs of normal spoilage should be charged to the good units that pass through that inspection point. This means that the costs of normal spoilage will continue through the process and not go to cost of goods sold. It is only the final inspection that will transfer costs to cost of goods sold for spoiled units.

Additional Classifications of Spoilage

Below are some additional terms that are similar to spoilage.

Shrinkage

Shrinkage is when a product simply evaporates or losses some of its quantity through time. We account for it in the same manner as spoilage – if it is normal it is charged to good units produced and if it is abnormal it is charged to the income statement.

Rework

When spoiled goods are fixed and prepared for sale, this is called rework. The costs incurred in rework of **normally** spoiled goods should be **charged to the factory overhead account** and allocated to all good units as part of factory overhead. Costs incurred in rework of **abnormally** spoiled units should be **expensed**.

Waste

Waste is the material that is left over after production is complete. It is simply unused and is now unusable materials.

Question 127: A company that manufactures baseballs begins operations on January 1. Finished baseballs are inspected and defective ones are pulled out. Defective baseballs cannot be economically salvaged and are destroyed. Normal spoilage is 3% of the number of baseballs that pass inspection. Cost and production reports for the first week of operations are: Raw materials cost - \$840 and Conversion cost - \$315. During the week 2,100 baseballs were completed and 2,000 passed inspection. There was no ending WIP. Calculate abnormal spoilage.

- a) \$33
- b) \$20.35
- c) \$22
- d) \$1,100

(CIA Adapted)

Question 128: Nance Co. began operations in January 2005 and uses the FIFO Process Costing method in its accounting system. After reviewing the first quarter results, Nance is interested in how the equivalent units produced would have been different if the weighted average method had been used instead. Assume that the number of units in ending work-in-progress were the same at the end of January, February and March and that at the end of each month they were the same percentage complete. If Nance had used the weighted average method, the EUP for conversion costs for each of the first two months would have compared to the FIFO method in what way?

	<u>January</u>	<u>February</u>
a)	Same	Same
b)	Greater number	Greater number
c)	Greater number	Same
d)	Same	Greater number

(HOCK)

Question 129: At the end of the first month of operations, Larkin had 2,000 units in ending WIP that were 25% complete as to conversion costs. All materials are added at the end of the process. The number of equivalent units of conversion costs would be:

- a) Equal to the number of units completed during the period.
- b) Less than the number of equivalent units of materials.
- c) Less than the number of units completed during the period.
- d) Less than the number of units placed into the process during the period.

(HOCK)

Question 130: A company employs a process cost system using the FIFO method. The product passes through both Department 1 and Department 2 in order to be completed. Units enter Department 2 upon completion in Department 1. Additional direct materials are added in Department 2 when the units have reached the 25% stage of completion with respect to conversion costs. Conversion costs are added proportionally in Department 2. The production activity in Department 2 for the current month was:

Beginning work-in-process inventory (40% complete with respect to conversion costs)	15,000
Units transferred in from Department 1	<u>80,000</u>
Units to account for	<u>95,000</u>
Units completed and transferred to finished goods	85,000
Ending work-in-process inventory (20% complete with respect to conversion costs)	<u>10,000</u>
Units accounted for	<u>95,000</u>

How many equivalent units for direct materials were added in Department 2 for the current month?

- a) 70,000 units.
- b) 80,000 units.
- c) 85,000 units.
- d) 90,000 units.

(CMA Adapted)

Question 131: The following data pertain to a company's cracking-department operations in December.

	<u>Units</u>	<u>Completion</u>
Work-in-process, December 1	20,000	50%
Units started	170,000	
Units completed and transferred to the distilling department	180,000	
Work-in-process, December 31	10,000	50%

Materials are added at the beginning of the process and conversion costs are incurred uniformly throughout the process. Assuming use of the FIFO method of process costing, the equivalent units of conversion performed during December were:

- a) 170,000 equivalent units.
- b) 175,000 equivalent units.
- c) 180,000 equivalent units.
- d) 185,000 equivalent units.

(CIA Adapted)

Question 132: A manufacturing firm has a normal spoilage rate of 4% of the units inspected; anything over this rate is considered abnormal spoilage. Final inspection occurs at the end of the manufacturing process. The firm employs the first-in, first-out (FIFO) method of inventory flow. The processing for the current month was as follows:

Beginning work-in-process inventory	24,600 units
Units entered into production	470,400 units
Units completed and passing inspection	(460,800) units
Units failing final inspection	<u>(22,600) units</u>
Ending work-in-process inventory	<u>11,600 units</u>

The equivalent units assigned to normal and abnormal spoilage for the month would be:

	<u>Normal Spoilage</u>	<u>Abnormal Spoilage</u>
a)	904 units	21,696 units
b)	18,432 units	4,168 units
c)	18,816 units	3,784 units
d)	19,336 units	3,264 units

(CIA Adapted)

Question 133: Assume 5,500 units were worked on during a period when a total of 5,000 good units were completed. Normal spoilage consisted of 300 units; abnormal spoilage, 200 units. Total production costs were \$2,200. The company accounts for abnormal spoilage separately on the income statement as loss due to abnormal spoilage. Normal spoilage is not accounted for separately. What is the cost of the good units produced?

- a) \$2,080
- b) \$2,120
- c) \$2,200
- d) \$2,332

(CIA Adapted)

Question 134: During May 2005, Mercer Company completed 50,000 units costing \$600,000, exclusive of spoilage allocation. Of these completed units, 25,000 were sold during the month. An additional 10,000 units, costing \$80,000, were 50% complete at May 31. All units are inspected between the completion of manufacturing and transfer to finished goods inventory. Normal spoilage for the month was \$20,000, and abnormal spoilage of \$50,000 was also incurred during the month. The portion of total spoilage that should be charged against revenue in May is

- a) \$50,000
- b) \$20,000
- c) \$70,000
- d) \$60,000

(CMA Adapted)

Overhead Allocation

Introductory Note on Overheads

There are actually two main types of overheads – manufacturing (or factory) overheads and nonmanufacturing overheads. In general, overheads are costs that can't be traced directly to a specific product or unit. Manufacturing overheads are overheads that are related to the production process (factory rent and electricity, for example), whereas nonmanufacturing overheads are not related to the production process. Examples of nonmanufacturing overheads are accounting, advertising, cafeteria and general corporate administration.

In these materials, we will first look at the allocation of manufacturing overheads. This is covered in a variety of methods that include standard allocation, activity-based costing, process costing, job-order costing, and life-cycle costing.

The allocation of nonmanufacturing overheads is covered in the section on service cost allocation. However, some of the concepts and ideas covered in manufacturing overhead are also applicable in the allocation of nonmanufacturing overheads.

Note: In order to help these study materials flow more easily, we will use the term "overhead" in the majority of situations, even when the term "manufacturing overhead" would be more technically accurate. If we use the term "manufacturing overhead" in every situation, the language becomes very cumbersome and more difficult to read. Also, the term "factory overhead" can be used in place of "manufacturing overhead" because the two are interchangeable terms.

Manufacturing Overhead Allocation

We have already covered the three main classifications of production costs. These are:

- 1) **Direct materials,**
- 2) **Direct labor, and**
- 3) **Manufacturing (or Factory) Overhead.**

Direct materials (DM) and direct labor (DL) are usually simple to trace to individual units or products because these costs are directly and obviously part of the production process. As such, there is little emphasis put on the determination of DM and DL on the CMA Exam. Rather, the emphasis is on the allocation of overhead.

Overheads are production and operation costs that a company cannot trace to any specific product or unit of a product. Because these costs are incurred and paid for by the company and are necessary for the production process, it is essential that the company know what these costs are and allocate them to the different products that are produced. This must occur so that the full costs of production and operation are known in order to set the selling prices for the different products. If a company does not take overheads into account when it determines the selling price for a product, there is significant risk that it will price the product so that it is actually selling at a loss. The price that a company charges may cover the direct costs of production, but it may not cover all of the indirect costs of production.

In this section we will talk about the allocation of manufacturing overheads in much greater detail. In later sections we will examine the allocation of nonmanufacturing overheads.

The categories of costs included in **factory overhead (OH)** are:

- 1) **Indirect materials** – materials not identifiable with a specific product or job, such as cleaning supplies, small or disposable tools, machine lubricant and other supplies;
- 2) **Indirect labor** – salaries and wages not directly attributable to a specific product or job, such as plant superintendent, janitorial services and quality control; and
- 3) **General manufacturing overheads**, such as facilities costs (factory rent, electricity and utilities) and equipment costs.

Note: Remember that **factory overhead** and **manufacturing overhead** are interchangeable terms that mean the same thing. Either may be used in a question.

Overheads may be either fixed or variable (or mixed). A **fixed overhead**, like a fixed cost, is one that does not change over the relevant range of activity or production. An example of a fixed manufacturing overhead is factory rent.

Variable overheads are costs that change as the level of production changes. Examples are plant electricity, equipment maintenance, utilities, etc.

The number of ways a company can allocate overhead are numerous and limited only by the imagination of the accountant, and now, the computer programmer. However, for the CMA Exam, there are only a few methods of allocation with which you need to be familiar. But, no matter the manner of allocation, it is simply a **mathematical exercise of distributing the overhead costs to the products that were produced** using some sort of basis and formula.

Standard (Traditional) Allocation Method

Traditionally, manufacturing overhead costs have been **allocated to the individual products** based on either the direct labor hours, machine hours, materials cost, units of production, weight of production or some similar measure that is easy to measure and calculate. The measure used is called the **activity base**. If a company allocated factory overhead based on direct labor hours, this meant that for every hour of direct labor that went into a specific unit, a certain amount of factory overhead (the determination of how much is covered below) would be allocated (or applied) to that product. By adding together the direct materials, direct labor and allocated manufacturing overhead, a company can determine the total cost of production.

Determining the Basis of Allocation

When choosing the basis of allocation (for example, direct labor hours or machine hours), it is important that the basis used for the allocation closely reflects the reality of the way in which the costs are actually incurred. For example, in a company that is highly automated, direct labor would most likely not be a good allocation basis for factory overhead because labor would not be a large part of the production process. In a company that produces very large, heavy items (such as an appliance manufacturer), the best basis to allocate overhead may be the weight of each product.

To best reflect the way that manufacturing overhead is incurred, it is preferable to use **different methods of allocation in different departments**. This is necessary because different departments 'incur' these manufacturing overhead expenses differently. A department that paints needs to allocate costs based on square footage or meterage of the painted products, while a department that assembles products may allocate costs based on the number of parts in a product.

The more manufacturing overhead allocation rates used, the 'more accurate' the allocation process will be. However, this increase in the 'accuracy' of the number will be offset by additional costs in the allocation process. The more bases used to allocate overhead, the more costs will be incurred to obtain the needed information for the allocation. Therefore, a company needs to find a balance between the usefulness of having more than one overhead allocation basis against the cost of making the needed calculations for the additional bases.

Note: The only time that it may be applicable to **use only one rate** for the factory is when production is limited to a **single product** or to different, but very similar products.

Calculating the Manufacturing Overhead Allocation Rate

Once the method, or basis, of manufacturing overhead allocation is determined, it is necessary to calculate the **predetermined manufacturing overhead allocation rate**. This is the amount of manufacturing overhead that will be charged (allocated) to each unit of a product for each unit of the allocation basis (direct labor hours, machine hours, and so on) used by that product (direct labor hour, machine hour, and so on) during production.

The rate that is used to allocate overhead is **calculated at the beginning of the year** and it will be used to allocate manufacturing overheads throughout the year. It is important to remember that this manufacturing overhead allocation rate is calculated at the beginning of the year and then used throughout the year. Because it is done at the beginning of the year, it must use budgeted, or expected, amounts. This rate is called the **predetermined rate** because it is calculated at the start of the period.

This predetermined rate, used throughout the period, is calculated as follows:

$$\frac{\text{Budgeted Dollar Amount of Manufacturing Overhead}}{\text{Budgeted Activity Level}^u}$$

It is critical that you use the **budgeted (expected) amounts** in this calculation. These are the costs and units of the allocation method that the company **expects to incur or use** during the upcoming year. Again, the company determines the allocation rate at the start of the year and uses it for the entire year for the application of the manufacturing overhead costs.

Clearly, the rate that is calculated at the beginning of the year is not going to be the actual rate that occurs during the year. However, in order to determine the cost of goods produced throughout the year, an estimated rate must be used. A company cannot wait until the end of the year to determine what the cost of production was.

Note: The calculation of the allocation rate that we will look at can also be done on a weekly or monthly basis. In such a situation, the process would be exactly the same except that the budgeted numbers would be for the upcoming week or month (or whatever time period is used).

^u This is the number of expected direct labor hours, direct labor cost, material cost, or machine hours for use during the period used as allocation basis. This is discussed in greater detail on the following page.

Determining the Level of Activity

In relation to the allocation rate, the company must decide what level of activity to use for its budgeted amount of the activity level. This is the decision regarding how many machine hours, or direct labor hours, the company plans to use during the year. As this is one of the two figures used in the determination of the manufacturing overhead rate, it will greatly impact the allocation rate.

In Section A of this book, we discussed the four choices for the activity level to use in calculating a standard cost for overhead. The same four options are also available when determining the activity level to use for manufacturing overhead allocation, even if standard costing is not being used. The four options are:

- **Theoretical, or ideal, capacity** – the level of activity that will occur if the company produces at its absolute most efficient level at all times. This is not a good basis to use because a company will not be able to achieve this level in the long run, and manufacturing overhead will be **underapplied**. (We will take a more detailed look at under- and overapplied manufacturing overhead later.)
- **Practical (or currently attainable) capacity** – the theoretical level reduced by allowances for idle time and downtime, but not for a decrease in sales demand. Though this basis is more realistic than theoretical capacity, it is still too optimistic and will also result in an **underapplication of manufacturing overhead**. This is because the amount that will be allocated for each machine hour (or direct labor hour) will be less than the amount that is actually used as a result of dividing the expected manufacturing overhead amount over more expected units. This leads to a smaller amount being applied per machine hour (or whatever the allocation base is).
- **Expected actual capacity utilization (or master budget capacity utilization)** – the amount of output actually expected during the next budget period based on expected demand. This level will result in a different overhead rate for each budget period because of increases or decreases in planned production due to expected increases or decreases in demand.
- **Normal capacity utilization** – the level of activity that will be achieved in the long run, taking into account seasonal changes in the business and cyclical changes. Seasonal changes in business result from the seasons during the year and cyclical changes are connected to the larger business cycle. Normal capacity utilization is the level of activity that will satisfy **average** customer demand over a long-term period such as 2-3 years.

The method that a company should use depends on the given situation and upon the company's purpose in using the activity level.

If the capacity utilization is being used in pricing decisions, the use of normal capacity can result in fixed overhead costs being spread over a small number of output units, causing high per-unit costs. This can result in high, noncompetitive selling prices and lead to a **downward demand spiral**. A downward demand spiral is a continuing reduction in demand that occurs when costs are too high. As demand drops, the cost per unit gets higher and higher, leading to more price increases, which lead to more reduction in demand, and so forth.

For example, a total cost per unit when fixed cost per unit is based on a low production level may cause a bid to be higher than it would be if it were based on fixed costs with a higher production level. This can cause the company to lose the business, which would cause the production level to be used in the next bid to be even lower and the price even higher. In this case, the use of theoretical capacity or practical capacity would avoid increasing unit costs if expected demand levels decrease.

Normal capacity is often used as a basis for long-term (multi-year) plans. For long-term planning purposes, the cost to produce one unit should not be higher in one accounting period than in another simply because demand and thereby production levels are expected to be lower and the fixed costs are spread over fewer units.

Since normal capacity is a long-run average, it has no particular meaning for judging current performance. Using normal capacity to evaluate current performance is misusing a long-run measure for a short-run purpose. The master budget capacity utilization is more meaningful for current period planning and control.

The company will have an under-application of manufacturing overhead any time the actual overhead incurred is greater than the amount of manufacturing overhead applied to production (the level of production achieved). This means that the manufacturing overhead charged to the products was actually less than the actual incurred manufacturing overhead. On the other hand, if the amount of manufacturing overhead applied is greater than the amount actually incurred, the manufacturing overhead will be over-applied, meaning that more manufacturing overhead was charged to the products than was incurred by the company.

At the end of the accounting period, variances that result from differences between the actual overhead incurred and the overhead applied must be resolved as part of the closing activities. These variances may be prorated among ending work-in-process, ending finished goods, and cost of goods sold for the period. Or, they may be 100% closed out to cost of goods sold. A third approach (though not often used) is to restate all amounts using actual cost allocation rates rather than the budgeted cost application rates.

If 100% of the variances are closed out to cost of goods sold, the use of master budget capacity or normal capacity will lead to the **highest net income** of these choices. This will be true whether actual overhead incurred is greater than overhead applied (i.e., overhead is under-applied) or whether overhead incurred is less than overhead applied (i.e., overhead is over-applied).

When master budget or normal capacity is used, the denominator level used will be the lowest of all the methods. (In some years, master budget capacity may be lower than normal capacity; and in other years, normal capacity may be lower than master budget capacity.) That means the resulting application rate will be the highest. Therefore, more manufacturing overhead will be allocated to the products throughout the period than it will be if theoretical or practical capacity is used. So, more manufacturing overhead will be included in the finished goods and work-in-process inventories on the balance sheet at the end of the period than would be the case with usage of the other denominator levels.

When the variances are 100% closed out to cost of goods sold, no adjustment is made to inventories as part of the closing entries. So inventories under normal capacity will remain higher than under the other methods. Since inventories are higher, cost of goods sold will be lower. That is the reason why net income will be higher when normal capacity is used and 100% of the variances are written off to COGS.

However, if variances caused by differences between the actual manufacturing overhead incurred and the overhead applied are prorated among inventories and cost of goods sold or if the amounts are restated using actual rates, the choice of the denominator level for allocating manufacturing costs during the period will have no effect on the end-of-period financial statements. Net income will be the same no matter which capacity level is used to set the overhead allocation rate for the period.

We will look at both over- and under-applied manufacturing overhead in more detail later.

Note: In some sources only the capacity concepts of theoretical (ideal) and practical (currently attainable) are given.

Allocating Manufacturing Overhead to the Units

Once the overhead allocation rate is determined, the company can allocate overhead to the individual units that are produced. This is done by multiplying the **predetermined rate** by **a given number of units of the allocation basis** that were either actually used or that were supposed to be used in the production of each unit.

This is a very simple mathematical operation, but it becomes a little more involved because the company must make a decision about which cost allocation method to use.

Costing System Methods

The amount of manufacturing overhead allocated to each unit of product depends upon the costing system that the company uses. There are three systems that you need to be aware of, and you must know how manufacturing overhead is allocated to a unit under each method. The three methods are standard, normal and actual costing systems.

- In a **standard costing system**, the company will multiply the predetermined manufacturing overhead rate (calculated earlier) by the **standard number** of the allocation base that **should be used** in producing one unit of product.
- In a **normal (or extended normal) costing system**, the predetermined manufacturing overhead rate (calculated earlier) is multiplied by the **actual number** of the allocation base that **was used** in producing the product.
- In an **actual costing system**, actual direct labor and materials costs are charged to the units, and the actual manufacturing overhead costs are allocated to the units.

Because actual costing does not use a predetermined rate to allocate manufacturing overhead (it is done when the actual costs are known), you need to focus on standard and normal costing and understand how manufacturing overheads are charged to the individual products under these two methods. This is shown in the following table:

	Application Rate	Allocation Base
Standard Costing	Standard (or Predetermined) Rate	Standard Usage of Allocation Base
Normal Costing	Predetermined Rate	Actual Usage of Allocation Base

The following points should be noted when comparing the three costing systems:

- 1) All three costing systems record the cost of inventory based on actual output.
- 2) Direct labor and direct materials are treated the same under normal and actual costing.
- 3) Normal and standard costing use the same overhead rate.
- 4) Standard costing is typically used with a flexible budget system. Standard costing is based on the inputs (i.e., direct materials, direct labor and factory overhead) that **should have been used** for the actual output produced.

It is important in a question that you identify whether the company uses standard or normal costing. If the company uses standard costing, you are interested only in the standard number of machine, direct and labor hours allowed to produce the units. The actual amount is necessary only if the company uses normal costing.

Example: RedHawks Co. produces bookshelves for shipment to distributors. The manufacturing overheads of RedHawks in 2010 are expected to be \$250,000. In a perfect situation, RedHawks has the capacity to produce 40,000 bookshelves. Last year, RedHawks produced 38,000 bookshelves, which was the most in company history. Management thinks that this was attributable to a performance bonus that was in place for management in 2009, but was not given in 2010. For the 7 years prior to last year, RedHawks produced an average of 35,000 bookshelves, with production always between 33,500 and 36,500.

The CFO of RedHawks is trying to determine how much it will cost to produce each bookshelf. He knows to do this, the manufacturing overhead must be included in each of the units.

Calculating the Predetermined Rate

If RedHawks uses the **theoretical capacity**, the allocation rate will be **\$6.25** per unit ($\$250,000 \div 40,000$ units).

If the manufacturing overhead allocation rate is determined using last year's performance (**practical capacity**), the allocation rate will be **\$6.58** per unit ($\$250,000 \div 38,000$ units).

Finally, if they use what had been the **normal capacity** prior to 2009, it would be **\$7.14** ($\$250,000 \div 35,000$ units).

Allocation of Manufacturing Overhead Under the Traditional Method

Let us assume that RedHawks actually produces 34,500 units in 2010. (Given the fact that there was no information about any other part of the process, overhead must be allocated per unit.) Under each of the three levels of capacity, there would be a different amount of manufacturing overhead allocated to the products. The allocation is made by multiplying the actual number of units by the predetermined rate.

Under theoretical capacity, RedHawks would have allocated **\$215,625** ($6.25 \times 34,500$ units).

Under last year's capacity, it would have allocated **\$227,010** ($6.58 \times 34,500$ units).

Under the normal capacity, it would have allocated **\$246,330** ($7.14 \times 34,500$ units).

Summary Analysis

As you can see, because the actual production was different from any of the bases used, the amount of overhead allocated was not correct. However, the amount of overhead allocated under normal capacity would be the closest to the expected amount of \$250,000.

If RedHawks had used the theoretical base at the beginning of the year in its calculation of cost per unit, the company would have run the risk of underpricing the bookshelves. This is because the amount of overhead would have been allocated to too many bookshelves – overhead would have been allocated to bookshelves that would never be made.

The Process of Accounting for Factory Overhead

As factory overhead costs are **actually incurred**, they are placed in a **factory overhead (OH) control account** with the following journal entry:

Dr **Factory Overhead Control** X
 Cr Cash or Accounts Payable X

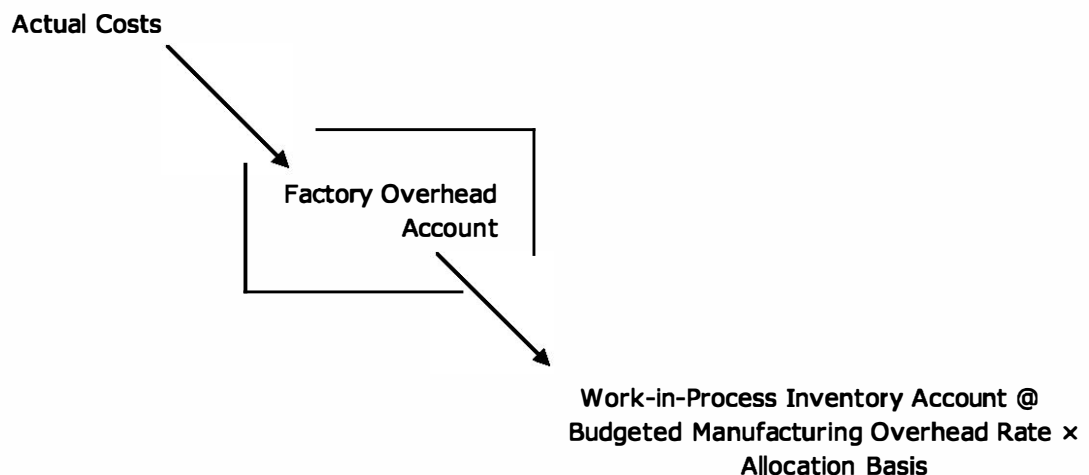
This account collects all of the actual factory overhead costs that the company incurs during the year. It is from this account that overhead will be allocated to work-in-process and then to finished goods.

As each unit is produced, some of this cost (using the predetermined rate calculated earlier) is transferred to the Work-in-Progress (WIP) account with this journal entry:

Dr WIP Inventory X
 Cr **Factory Overhead Control** X

The Work-in-Progress account is one of the inventory accounts for the company (the others are finished goods and raw materials), and when the overheads are transferred into the WIP account, they become what we call **applied**.

What is happening in the accounting process is that the Factory OH Control account is receiving the actual costs that the company incurs, and then the costs are allocated out from the Factory OH Control Account to the to the WIP account and applied to goods that are produced, using some sort of budgeted rate. Graphically it looks like this:



The amount allocated out from the Factory OH Control Account will not be exactly the same amount as the actual costs that came into the Factory OH Control account when the actual costs were incurred. If the amounts that come out during a period are **less** than the incurred amounts, the overhead is **under-applied**. If the amounts that come out during a period are **greater** than the incurred amounts, overhead is **over-applied**. The amount of the difference is a **variance**, and it remains in the Factory OH Control Account until the period is closed. This will be explained in more detail in the pages that follow.

After the costs are moved into the WIP account, they will be in one of three places in the financial statements at the end of the year. Where they are on the financial statements depends on what happened to that unit by the end of the year. The three possible locations in the financial statements are:

- 1) **Cost of Goods Sold** on the income statement if the item has been sold,
- 2) **Finished Goods Inventory** on the balance sheet if the item has been completed, but not sold, or
- 3) **Ending WIP** on the balance sheet if the item has not been completed.

Over-Applied and Under-Applied Manufacturing Overhead

Chances are very good that the **actual costs incurred** and/or the **actual level of activity** during the period will be different from the estimation at the start of the year. This is problematic because of the fact that the actual costs are being allocated using the budgeted costs and budgeted usage of the allocation basis. If the actual costs or usage are different from the budgeted, this allocation will be, in essence, "incorrect." As a result, the overhead control account will have a balance in it at the end of the year. This balance may be positive or negative, but in any case it needs to be eliminated from this account.

If the balance is a debit balance (a balance still remains in the OH Control account), it means that we **under-applied factory overhead** to the products. In other words, the amount of factory overhead that was applied during the period was **less** than the actual factory overhead incurred during the period.

Alternatively, if the OH Control account has a credit balance (negative balance), it means we **over-applied factory overhead to the products**. In other words, the amount of factory overhead that was applied during the period was **greater than** the actual factory overhead costs incurred during the period.

The amount of over- or under-applied factory overhead is calculated as follows:

$$\begin{aligned} & \text{Actual Costs Incurred} \\ - & \text{Factory Overhead Applied During the Period} \\ = & \text{Under (Over) Applied Factory Overhead} \end{aligned}$$

In either of these situations, the company needs to correct this imbalance, because it is not reasonable to have a balance in this account at the end of the period. Therefore, this remaining balance (the amount over- or under-applied) in the overhead control account must be removed from the account.

The way we transfer out this remaining over- or under-applied balance depends on whether the balance is immaterial or material.

Immaterial Amount

If the **under-applied** amount is immaterial it will simply be charged to COGS in that period. This will increase the COGS amount and decrease the profit for the period.

If the **over-applied** amount is immaterial, this will be taken out of COGS, reducing this amount and increasing the profit for the period.

Material Amount

If the amount that was over- or under-applied is **material**, it must be distributed to the **WIP Inventory, Finished Goods Inventory, and Cost of Goods Sold** accounts. This distribution will be made proportionally to each of these three accounts based upon the number of units in each of these categories. An under-applied amount will be added to these accounts while an over-applied amount will be taken out of these accounts.

The process of the allocation of the material over- or under-applied overhead makes it as if the correct, actual rate of allocation had been used during the year. In the case of the under-application of overhead, this adjustment at the end adds to the value (or cost) of each of the goods produced during the year. In the situation of over-applied overhead, this allocation reduces the value (or cost) of each item produced during the period.

Comprehensive Example of Accounting for Fixed Overhead and FOH Variances

The following example should help to clarify the way manufacturing overhead is handled in a standard cost accounting environment.

This example focuses on fixed overhead because fixed overhead is a little more difficult to see, conceptually, than the variable manufacturing costs. However, the basic principles are applicable to all manufacturing costs, because all manufacturing costs are applied to units as the units are produced. The difference between fixed overhead costs and variable costs (both variable overhead and direct costs) is that for fixed overhead, the predetermined overhead rate per unit of the allocation base is a calculated amount, calculated by dividing the fixed total by the anticipated volume. If production volume increases or decreases, the total fixed cost does not change as long as the volume stays within the relevant range. With variable costs, this per unit calculation is not necessary because the cost per unit is a given, known amount; and the total cost increases when volume increases and decreases when volume decreases. However, variable costs are applied to production as production progresses, just as fixed costs are.

This example integrates the concepts from budgeting, performance management (variance reporting) and overhead allocation that we have studied so far in this book.

- 1) When the company makes up its budget for the coming year, it determines what its budgeted fixed manufacturing overhead will be. For this example, budgeted fixed manufacturing overhead for the coming year is \$10,000,000.
- 2) The company projects how many units it will produce during the year. This is where the different capacity levels that a company may use come in. Those are covered in this textbook in the section on Budgeting, under the heading "Determining the Level of Activity." Review those if you need to before reading further. The company must decide what capacity level it will base its forecast on for the number of units it will plan to produce. For simplicity's sake, we will assume this company has only one product. So we will say that the company projects it will produce 1,000,000 units, using whichever capacity level it chooses to use.
- 3) The company sets the standard for the quantity of the application base to be used for each unit to be produced. This company is allocating fixed overhead on the basis of machine hours, and each unit is expected to require 5 machine hours. Therefore, 5,000,000 machine hours will be required to produce 1,000,000 units.
- 4) The company takes its total budgeted fixed manufacturing overhead for the coming year (\$10,000,000) and divides it by the 5,000,000 machine hours it plans to use in the coming year. This gives it the budgeted, or standard, fixed overhead cost per unit of the cost allocation base used. This per unit amount is also called the predetermined rate. The standard (predetermined) fixed overhead rate for the coming year is \$2 per machine hour and, since 5 machine hours are required per unit, it is \$10 per unit.
- 5) The next year begins. Fixed overhead costs (like rent, plant supervisor and janitorial salaries, etc.) are paid, and manufacturing production progresses. As each fixed cost is incurred, the accounting department debits an account called Factory Overhead Control for the cost and credits Accounts Payable or whatever other account is appropriate (i.e., accrued compensation costs for salaries). The actual costs will almost certainly not be exactly equal to the budgeted cost of \$10,000,000. In this case, the actual total fixed overhead costs for the year turn out to be \$11,000,000 when the year is over.

- 6) At the same time as the actual costs are being paid, the cost accountants are getting reports from the factory floor about the number of units being manufactured. For each unit that is manufactured, the cost accountants apply 5 machine hours $\times$ \$2 per machine hour, or \$10 of fixed overhead to that unit. They do not worry about what the actual costs are at this point. When the accountants apply the fixed overhead, they debit Work-In-Process Inventory and credit Factory Overhead Control for \$10 of fixed overhead for each unit manufactured. (The same thing is done for variable costs, as well.) This is done because as the year progresses, no one knows what the **actual** fixed costs incurred will be at the end of the year. But by applying this predetermined rate to production, the company can have a close estimate of what its total production costs are as the year goes on. During the year, 1,200,000 units are manufactured. Therefore, $1,200,000 \times \$10$, or \$12,000,000 of fixed overhead will be applied to the units produced. This applied overhead flows first to Work-In-Process inventory, then to Finished Goods Inventory as the units are completed, and finally, when the units are sold, to Cost of Goods Sold.
- 7) By the end of the year, the company has three amounts: **Budgeted** fixed overhead of \$10,000,000; **Actual** fixed overhead of \$11,000,000; and **Applied** fixed overhead of \$12,000,000. The Total Fixed Overhead Variance is the Actual Fixed Overhead of \$11,000,000 minus the Applied Fixed Overhead of \$12,000,000, or \$(1,000,000). Because \$1,000,000 more overhead was applied than was actually incurred, the fixed overhead is **over-applied** by \$1,000,000.
- 8) The company must make the year-end account balances reflect only the Actual fixed overhead incurred, because both the budgeted and the applied fixed overhead are just estimates. This **Total Fixed Overhead Variance** of \$(1,000,000) right now is in the Factory Overhead Control account. Remember we said that as actual costs are paid, they are debited to the Factory OH Control account, and as the overhead is applied to production, the amount applied is credited to the Factory OH Control account. Therefore, the Factory OH Control account has been debited for \$11,000,000 and credited for \$12,000,000. It has a credit balance of \$(1,000,000), which is also the Total Fixed Overhead Variance. That variance will be moved out of the Factory OH Control account by the accountants in the year-end adjusting entries they will make.
- 9) The Total Fixed Overhead Variance can be split into two different variances, to permit management to better analyze it and understand what caused it. Those two variances are:
- 10) **Fixed Overhead Budget (or Fixed Overhead Spending) Variance**, which is Actual Fixed Overhead Incurred minus Budgeted Fixed Overhead. Here, that is \$11,000,000 – \$10,000,000, which is \$1,000,000. This is a positive number, because Actual Fixed Overhead Incurred was greater than Budgeted Fixed Overhead. This might be considered an Unfavorable variance, because actual costs were higher than planned. However, remember that actual production was 1,200,000 units, which was 200,000 greater than the 1,000,000 units that were planned. So actually, the fixed overhead **cost per unit** was **less** than planned, because the fixed overhead cost per unit actually produced was $\$11,000,000 \div 1,200,000$ units, or \$9.16 per unit.
- 11) **Fixed Overhead Production-Volume Variance**. This variance is Budgeted Fixed Overhead minus Applied Fixed Overhead. Here, that will be \$10,000,000 – \$12,000,000, which is \$(2,000,000), a negative number. This variance tells management that more fixed overhead was applied than had been budgeted for. The reason more fixed overhead was applied than was budgeted for is, of course, because production was higher than planned. And that is a good thing. **So a negative Fixed Overhead Production-Volume Variance is a Favorable variance.**
- 12) These two variances – \$1,000,000 Fixed Overhead Budget Variance plus \$(2,000,000) Fixed Overhead Production-Volume Variance – total to \$1,000,000, which is the Total Fixed Overhead Variance.

- 13) The cost accountants will need to clear this fixed overhead variance out of the Factory OH Control account at the end of the year. How they do it depends upon how management has decided it should be done. This decision is usually based on whether the amount of the variance is immaterial or material.
- 14) **Immaterial Amount** – If an **under-applied** amount is immaterial it will simply be debited to COGS in that period. This will increase the COGS amount and decrease the profit for the period. If an **over-applied** amount is immaterial, it will be credited to COGS, reducing this amount and increasing the profit for the period.
- 15) **Material Amount** – If the amount that was over- or under-applied is **material**, it must be distributed to the **WIP Inventory, Finished Goods Inventory, and Cost of Goods Sold** accounts. This distribution will be made proportionally to each of these three accounts based upon the number of units in each of these categories. An under-applied amount will be added (debited) to these accounts while an over-applied amount will be taken out of (credited to) these accounts. If the amount of the variance is allocated proportionally to the inventories and cost of goods sold accounts in this manner, the process allocating the variance makes it as if the correct, actual rate of allocation had been used all during the year. In the case of the under-application of overhead, this adjustment at the end adds to the value (or cost) of each of the goods produced during the year. In the situation of over-applied overhead, this allocation reduces the value (or cost) of each item produced during the period.
- 16) Since in this example the fixed overhead has been over-applied, the cost accountants will debit Factory OH Control for \$1,000,000 and credit other accounts to close it out. This will take the balance for fixed overhead in the Factory OH Control account to zero. The accountants may put the whole credit toward Cost of Goods Sold, thereby decreasing COGS expense by \$1,000,000. Or, they may pro-rate the \$1,000,000 credit among COGS, Finished Goods Inventory and Work-In-Process Inventory. If the variance is allocated among COGS, FG and WIP, then the financial statements will be the same as if the actual allocation rate (actual cost incurred ÷ actual production volume) had been used all year, instead of the predetermined allocation rate. However, if the whole variance is cleared out as an adjustment to COGS only, then the financial statements will be slightly distorted. This is acceptable **only** if the amount of the variance is not material. In this case, if the whole \$1,000,000 variance is credited to COGS, then net income will be slightly higher than it would have been if the variance had been pro-rated among COGS and FG and WIP, because total expenses will be slightly lower.
- 17) If all of the variances are written off to COGS, then the value of the finished goods in the Ending Finished Goods Inventory will reflect only the standard, budgeted amount of fixed overhead (and direct materials, direct labor and variable overhead, too) for each unit of goods in ending FG inventory.

Note: In questions about overhead allocation on the exam, you need to make certain that you identify the allocation base. It may be machine hours, direct labor hours, direct labor costs, weight, size, or something similar. It is also possible that in a question there will be **more than one overhead allocation base**. This simply means that you need to perform the mathematics of overhead allocation more than once and then simply add the numbers together. In this case, the question is not any more difficult; it just takes longer to do since you need to perform the same operation more than once. This is seen in the following question.

Question 135: A company allocates overhead to jobs in process using direct labor costs, raw material costs and machine hours. The overhead application rates for the current year are:

- 100% of direct labor.
- 20% of raw materials.
- \$117 per machine hour.

A particular production run incurred the following costs:

- Direct labor, \$8,000
- Raw materials, \$2,000
- A total of 140 machine hours were required for the production run.

What is the total cost that would be charged to the production run?

- a) \$18,000
- b) \$18,400
- c) \$24,780
- d) \$34,780

(CIA Adapted)

Question 136: During the current accounting period, a manufacturing company purchased \$70,000 of raw materials, of which \$50,000 of direct materials and \$5,000 of indirect materials were used in production. The company also incurred \$45,000 of total labor costs and \$20,000 of other factory overhead costs. An analysis of the work-in-process control account revealed \$40,000 of direct labor costs. Based upon the above information, what is the total amount accumulated in the factory overhead control account?

- a) \$25,000
- b) \$30,000
- c) \$45,000
- d) \$50,000

(CIA Adapted)

Question 137: The following information is available from the records of a manufacturing company that applies factory overhead based on direct labor hours.

Estimated overhead cost	\$500,000
Estimated labor hours	200,000
Actual overhead cost	515,000
Actual labor hours	210,000

Based on this information, factory overhead is:

- a) Underapplied by \$9,524.
- b) Overapplied by \$10,000.
- c) Overapplied by \$40,750.
- d) Underapplied by \$15,000.

(CIA Adapted)

Question 138: On January 1, 2005, the first year of operations, Paterno Co. had the following annual budget.

Units	<u>20,000</u>
Sales	\$120,000
Minus:	
Total variable expenses	70,000
Total fixed expenses	<u>25,000</u>
Net income	<u>\$ 25,000</u>
Factory overhead:	
Variable	\$40,000
Fixed	20,000

At the end of the first year, there were no units in progress and the actual total factory overhead incurred was \$45,000. There was also \$3,000 of overapplied factory overhead. Factory overhead was allocated on a basis of budgeted units of production. How many units did Paterno produce this year?

- a) 14,000
- b) 16,000
- c) 20,000
- d) 23,333

(HOCK)

Activity-Based Costing

Activity-based costing (ABC) is another way of allocating overhead costs to products, and in ABC the method of allocation is based on cost drivers. As with the other methods, ABC is a mathematical process of allocation and requires identification of the costs to be allocated, followed by some manner of allocating them to the produced products. We can use ABC in a variety of situations and apply it to both manufacturing and nonmanufacturing overheads. It can also be used in service businesses.

By definition, according to the Statement of Management Accounting, activity-based costing:

"identifies the causal relationship between the incurrence of cost and activities, determines the underlying driver of activities, establishes cost pools related to individual drivers, develops costing rates, and applies cost to product on the basis of resources consumed (drivers)."

Activity-based Costing is a costing system that focuses on individual activities as the fundamental cost objects.

- An **activity** is an event, task or unit of work with a specified purpose. Examples of activities are designing products, setting up machines, operating machines, making orders or distributing products.
- A **cost object** is anything for which costs are accumulated for managerial purposes. Examples of cost objects are a specific job, a product line, a market or certain customers.
- A **cost driver** is anything (it can be an activity, an event or a volume of something) that causes costs to be incurred each time the driver occurs. Examples of cost drivers are set-ups, moving, number of parts, casting, packaging or handling.

Traditional versus ABC Costing Methods

Traditional costing methods classify costs as product costs or period costs. Product costs are direct materials, direct labor, and factory overhead and are allocated to products according to some cost driver such as machine hours used or direct labor used. Product costs are attached to units of inventory, and they are put into Inventory on the balance sheet and charged as expense when the units they are attached to are sold. Period costs include selling and general and administrative costs, and period costs are charged against income in the period they are incurred and are not allocated to products at all.

In ABC Costing, the premise is that the cost of a finished product should include the cost of direct materials, direct labor and overhead costs directly attributable to that product, and it should also include a portion of the administrative costs necessary to produce the product. For example, the cost of a product also includes the administrative costs to buy the raw materials, including writing specifications, obtaining bids, issuing purchase orders, etc. Therefore, these costs are also analyzed and allocated to products. This means that products will be charged with the costs of both manufacturing and nonmanufacturing activities. It also means that some manufacturing costs will not be attached to products at all, if they have no direct relationship to the production of the products. For example, the salary paid to the security guard at the plant entrance is an overhead cost in a traditional cost system that is included in the fixed overhead that is allocated to products on the basis of machine hours or direct labor hours. But in ABC Costing, that plant guard's salary would not be directly related to the cost of producing any of the products, and so it would be excluded from the product costs.

Furthermore, traditional costing systems allocate costs according to general usage of resources, such as usage of machine hours or direct labor used. These resources used may or may not have any connection with the costs being allocated. With ABC, the cost allocations are not based on usage of resources. Instead, they are based on **activities performed** and what those activities cost. ABC Costing is much more detailed than traditional costing, because it uses many more cost pools and each cost pool has its own cost driver.

Note: ABC is becoming more of a necessity for many companies, since traditional systems may use direct labor to allocate overheads and direct labor is becoming a smaller part of the overall production process.

Essentially, activity-based costing is **very similar to the standard method of overhead allocation**, except for the fact that we have many cost drivers, and these cost drivers should have a direct relationship to the incurrence of costs by an individual product. Therefore in the application of ABC, you simply need to perform many different overhead allocations as above. The main difference is the determination of what the allocation bases are going to be. On the Exam in an ABC question that is numerical, you should be prepared to make three or four allocations of different cost pools to the final product.

The ABC Process

Setting up an ABC system is more difficult, time consuming and costly than setting up a traditional system, because a company must first analyze the production process and decide what activities cause costs to be incurred. Companies may identify a number of different cost drivers and use each of them to allocate overhead. Each cost driver requires the company to keep records and increases the complexity of the ABC system.

Identification of Activities

As part of the process of analyzing the production process, the company may identify some **non-value adding activities**. Non-value adding activities are those activities that do not add any value for the end consumer. When the company identifies these activities, it should try to reduce or eliminate them. This reduction of non-value adding costs is an additional benefit to the company (in addition to more accurate costing of products) and can lead to a reduction in the cost of production. In turn, this will either enable the company to reduce the sales price or to recognize more profit from the sale of each unit.

Opposite from non-value adding activities, are **value-adding activities**. As the name suggests, these are activities (costs) that add value to the customer. Even though these activities are value-adding, they must be monitored to make certain that the costs are not excessive. The different categories of costs are listed below.

Note: Fortunately, on the CMA Exam you will generally not need to identify the cost drivers or cost pools in a large question because they will be provided for you. You will simply need to use the provided information to determine the amount of overhead that will need to be allocated to any product. In a smaller question it is possible that you will need to determine the appropriate driver, but these are usually fairly direct, and if you simply think about what would cause costs to be incurred, you will see the correct answer.

Calculation of Allocation Rate and Allocation

An **allocation rate** is then calculated **for each of the cost drivers**. This process is like that done under the traditional method (expected costs allocated to the cost driver ÷ the expected usage of the cost driver). The costs are then allocated to the products based upon the usage of the cost driver of each product.

The manufacturing overhead costs that the company incurs are accumulated in **cost pools**. Each cost pool is associated with one of the cost drivers (activities). A cost pool is similar to the traditional overhead account for each activity, or cost driver. These cost pools collect the costs associated with the various activities (drivers) that incur the costs, and then the costs are allocated as the drivers are used or consumed in the production of the product.

This process of cost allocation is similar to the accumulation of actual manufacturing overhead costs that we discussed in the standard method. The difference is that in ABC there are many cost pools and drivers, so the calculations will need to be performed many times. Because of the increased number of allocation bases, ABC provides a more accurate costing of the products. As we covered in the standard method, a company should use only one allocation base if it produces only one product. ABC uses many allocation bases to try to reflect the different consumptions of overhead activities between products.

Categories of Activities

There are four categories of activities, based upon where the activity occurs in relation to the final product and the facility as a whole. These four categories are:

- 1) **Unit-level activities** – These activities are performed for each unit that is produced. Some examples are hours of work, inspecting each item, operating a machine and performing a specific assembly task.
- 2) **Batch-level activities** – These activities occur each time a batch is produced. Some examples are machine setup, purchasing, scheduling, materials handling and batch inspection.

- 3) **Product-sustaining activities** – These activities are incurred in order to support the production of a different product from what is currently produced. Examples include product design and engineering changes.
- 4) **Facility-sustaining activities** – These activities are incurred to support production in general, such as security, maintenance, plant management, depreciation of the factory and property taxes.

Facility-sustaining activities and associated costs present a small issue that requires a company decision. Given the broad nature of these costs, it is very difficult to allocate them in any reasonable manner to the final goods. However, a company may either try to allocate these costs, or the company may simply expense them in the period incurred. For external purposes they are usually allocated so as to maintain an absorption costing that is acceptable for GAAP.

Facility-sustaining activities allocated under ABC can also include selling and administrative expenses that would be expensed for external purposes. For internal analysis, they can be included in the ABC cost allocations to products, even though for external reporting, they are period costs and are expensed as they are incurred.

Note: You need to know these different categories of activities more for word questions than for numerical questions. The allocation methods are the same for all of the activities, but what they relate to is different.

Advantages and Disadvantages of ABC

Some of the **advantages** of ABC are:

- ABC provides a more accurate product cost for use in pricing and strategic decisions.
- By identifying the activities that cause costs to be incurred, ABC enables management to identify activities that do not add value to the final product.

Some of the **disadvantages** of ABC, however, are:

- Not everything can be allocated strictly on a cost driver basis. This is particularly true in respect to facility-sustaining costs.
- It is expensive and time consuming to implement and maintain.

ABC will **provide the most benefits to companies that produce very diverse products** or have complex activities. For companies that produce relatively similar products or have fairly straightforward processes that are consumed equally by all products, the costs of ABC probably outweigh the benefits.

Note: In respect to ABC, two more terms with which you need to be familiar are resource drivers and activity drivers. These are details in the allocation process and you are not expected to know this for a numerical question, but perhaps for a word question.

A **cost driver** (discussed above) is an event, factor or activity that causes cost to arise and be incurred. It can be the level of activity or volume (for example, production volume or the number of purchases). The main idea is a cause-and-effect relationship between an activity and the incurrence of costs. For example, as an activity such as purchasing increases, all of the costs associated with that purchase also increase – costs of shipping, insurance, telephone, etc. If there are no purchases, there will not be any purchasing costs. So, a purchase could be a cost driver.

A **resource driver** is a measure of the quantity of resources consumed by an activity. In the above example, the resource driver measures how much of the total costs incurred by the company are consumed by the “purchasing” activity. This is the determination of the total costs of the cost driver.

An **activity driver** measures how much of the activity (purchasing) is used by the cost object (Product A, for example). We have to assign all costs associated with Product A using ABC to Product A. Using the above example, we need to assign purchasing costs to product A. An activity driver is the measure of the demand for the purchasing activity by the cost object (in this case, Product A). In this case it could be number of purchase orders that are required to purchase the parts for Product A.

Question 139: Cost drivers are:

- a) Accounting techniques used to control costs.
- b) Accounting measurements used to evaluate whether performance is proceeding according to plan.
- c) A mechanical basis, such as machine hours, computer time, size of equipment or square footage of factory used to assign costs to activities.
- d) Activities that cause costs to increase as the activity increases.

(CMA Adapted)

Here are three examples of how ABC costing might be used in a real situation.

Example #1: A manufacturing firm. In a manufacturing environment, product setup is required every time the production line changes from producing one product to producing another product.

The **cost driver** is product setups. An engineer might be required to supervise the setup of the line for the product change. Suppose the engineer spends 20% of his or her time supervising setups (the **resource driver**). So 20% of the engineer's salary and other expenses will be costs to be allocated according to the amount of time the engineer spends supervising each product's setup as a percentage of the amount of time spent supervising all product setups (the **resource driver**).

And not only is the engineer required. Production supervisors are also required to supervise product setup, and they spend 40% of their time doing that (the **resource driver** again).

All of the costs of product setup are collected in a "product setups" cost pool. Setup time spent on each product as a percentage of setup time spent on all products is the **activity driver**. The total costs in the pool, including 20% of the engineers' costs and 40% of the production supervisors' costs, would be allocated according to the activity driver, which is the proportion of total setup time spent on each product as a percentage of total setup time spent on all products.

Example #2: A service firm. Bank tellers process all kinds of transactions. The transactions relate to many different banking services that the bank offers. Transactions processed are the **cost driver**. How should the tellers' time, the teller machines used by the tellers, the supplies used by the tellers and the space occupied by the tellers be allocated among the various services offered by the bank (checking accounts, savings accounts, and so forth) in order to determine which services are most profitable?

The bank would do time and motion studies to determine the average time that it takes tellers to process each type of transaction (checking account transactions, savings account transactions, and so forth). Then, information on how many of each type of transactions processed by tellers is captured. The average time for each type of transaction is multiplied by the number of transactions processed. The percentage of teller time spent on each type of transaction as a percentage of the amount of teller time spent on all types of transactions is the **activity driver**.

If the tellers spend 90% of their time performing teller transactions and 10% of their time doing something else like answering telephones, then that 90% is the **resource driver** for the tellers' salaries. 90% of the tellers' salaries will be put into the "tellers" cost pool along with 100% of the costs of their teller machines, their supplies, and the square footage occupied by their teller stations. Then the percentage of tellers' time spent on each type of transaction in relation to their total time spent on all teller transactions (the **activity driver**) is used to allocate the teller costs in the cost pool proportionately among the bank's various services.

Example #3: A manufacturing, sales or service firm. An invoicing clerk who prepares invoices for the whole company is creating invoices for all of the products and/or services that the company provides. The invoicing is a necessary activity, because without it, the company would not receive payment. It does not take an invoicing clerk any longer to create a line on an invoice for a quantity of 1,000 units of a product or 1,000 hours of service than it does to create a line on an invoice for a quantity of 1 unit of the same product or 1 hour of the same service. So even though the revenue for 1,000 units will be 1,000 times as much as the revenue for 1 unit, it would not be right to charge the 1,000 unit product or service for 1,000 times more of the invoicing clerk's expenses when 1,000 units are invoiced than when just 1 unit is invoiced. But if the invoicing clerk's costs were being allocated to products and services on the basis of revenue invoiced, that is exactly what would happen. ABC Costing can make the allocation of the clerk's costs more equitable.

In this example, the **cost driver** is the number of lines on invoices (not sales dollars invoiced). The number of lines on invoices is the cost driver because the more lines that need to be invoiced, the more of the clerk's time will be required. And if the volume grows so much that the one invoicing clerk cannot do it all, then a second invoicing clerk will have to be hired. That is how lines on invoices drive costs.

Besides the clerk's salary, the invoicing clerk needs a desk and a computer and a file cabinet and office space and a telephone. A **resource driver** is a measure of the consumption of a resource, and it is used to determine the portion of total resource cost assigned to each activity. In this example, the resource driver is the percentage of the invoicing clerk's time spent on invoicing. For example, the volume of invoicing may require only 50% of the invoicing clerk's time, and the other 50% of the clerk's time is spent assisting the marketing department, a totally unrelated activity. In this case, only 50% of the invoicing clerk's salary and 50% of the costs for the other resources used by the invoicing clerk should go into the "invoicing" cost pool.

All of the costs related to invoicing make up one **cost pool**. In a good accounting system, it should be possible to capture information on how many lines are invoiced for each of the company's products during a given period of time. So the total costs in the cost pool are divided by the total number of lines of invoicing done by the clerk to calculate a cost per line. Then, the total cost is allocated to products and/or services according to usage.

The company may want to allocate the invoicing clerk's costs in any of a number of ways, depending on how management wants to see them. Geographical area, department, and product are just a few of the possible ways. If the company wants to see the costs allocated by product or service, for example, the number of invoice lines created for each product/service during the period will be retrieved from the accounting system. The number of invoice lines used by each product as a percentage of the total invoice lines used by all products will be calculated, and that is the **activity driver**. To find the amount of the invoicing clerk's costs to allocate to each product, the company will simply multiply the total costs in the pool by the percentage of total usage by each product or service.

In an ABC system, all indirect and overhead costs are analyzed in this way. The analyst groups costs into cost pools and looks for what the cost driver is for that cost pool. The cost driver activity is analyzed to determine what percentage of the activity is being used by each product/service (the activity driver). The costs in the cost pool are then allocated to products/services proportionately to the amount of the activity that was used by each one. This enables the company to see which products or services are more profitable than others. It also enables the company to set prices to cover the full cost of providing each product or service so that very profitable products are not subsidizing unprofitable products.

In ABC, the cost driver for a cost pool can be anything at all that causes indirect or overhead costs to arise, as long as those costs can be allocated to individual products or services (or organizational units, if management wishes) in some meaningful way.

Question 140: Which of the following statements about activity-based costing is not true?

- a) Activity-based costing is useful for allocating marketing and distribution costs.
- b) Activity-based costing is more likely to result in major differences from traditional costing systems if the firm manufactures only one product rather than multiple products.
- c) In activity-based costing, cost drivers are what cause costs to be incurred.
- d) Activity-based costing differs from traditional costing systems in that products are not cross-subsidized.

(CIA Adapted)

The following information is for the next two Questions: Zeta Company is preparing its annual profit plan. As part of its analysis of the profitability of individual products, the controller estimates the amount of manufacturing overhead that should be allocated to the individual product lines from the information given as follows:

	<u>Wall Mirrors</u>	<u>Specialty Windows</u>
Units produced	25	25
Material moves per product line	5	15
Direct labor hours per unit	200	200

Budgeted materials handling costs - \$50,000 in total

Question 141: Under a costing system that allocates manufacturing overhead on the basis of direct labor hours, the materials handling costs allocated to one unit of wall mirrors would be:

- a) \$1,000
- b) \$500
- c) \$2,000
- d) \$5,000

Question 142: Under activity-based costing (ABC), the materials handling costs allocated to one unit of wall mirrors would be:

- a) \$1,000
- b) \$500
- c) \$1,500
- d) \$2,500

(CMA Adapted)

Note: This is a very good example of a question where you may need to determine the cost under both ABC and the traditional method. Make certain that you are able to do this.

The following information is for the next two Questions: Believing that its traditional cost system may be providing misleading information, an organization is considering an activity-based costing approach. It now employs a full cost system and has been applying its manufacturing overhead on the basis of machine hours.

The organization plans on using 50,000 direct labor hours and 30,000 machine hours in the coming year. The following data shows the budgeted manufacturing overhead.

<u>Activity</u>	<u>Cost Driver</u>	<u>Budgeted Activity</u>	<u>Budgeted Cost</u>
Material handling	No. of parts handled	6,000,000	\$ 720,000
Setup costs	No. of setups	750	315,000
Machining costs	Machine hours	30,000	540,000
Quality control	No. of batches	500	<u>225,000</u>
Total Manufacturing Overhead Cost			\$1,800,000

Cost, sales and production for one of the organization's products for the coming year are as follows:

Prime Costs

Direct material cost per unit	\$4.40
Direct labor cost per unit = .05 DLH @ \$15/DLH	<u>.75</u>
Total Prime Cost	<u>\$5.15</u>

Sales and Production Data

Expected sales	2,000,000 units
Batch size	5,000 units
Setups	2 per batch
Total parts per finished unit	5 parts
Machine hours required	80 MH per batch

Question 143: If the organization uses the traditional full cost system, the cost per unit for this product for the coming year will be:

- a) \$5.39
- b) \$5.44
- c) \$6.11
- d) \$6.95

Question 144: If the organization employs an activity-based costing system, the cost per unit for the product described for the coming year will be:

- a) \$6.00
- b) \$6.08
- c) \$6.21
- d) \$6.30

(CIA Adapted)

Job-Order Costing

Job-order costing is a method in which all of the costs associated with a specific job (or client) are accumulated and charged to that job (or client). The costs are accumulated on what is called a job-cost sheet. All of the job sheets that are still being worked on equal the work-in-progress at that time. In this system, costs are recorded on the job-cost sheets, and not necessarily in an inventory account.

This method can be used when all of the products or production runs are identifiable and unique from each other. A good example of this is an audit or legal firm. As employees work on a particular client or case, they charge their time and any other costs to that specific job. At the end of the project, the company simply needs to add up all of the costs assigned to it to determine the cost. Performance measurement can be done by comparing each individual job to its budgeted amounts or by using a standard cost system.

While direct materials and direct labor are accumulated on an actual base, manufacturing overhead must be allocated to each individual job. This is done in much the same manner as has already been explained. A predetermined rate is calculated and applied to each product based either on:

- 1) Actual usage of the allocation base (**normal costing**), or
- 2) Standard usage of the allocation base (**standard costing**).

Note: In the allocation method called **extended normal costing**, the direct costs (materials and labor) are also allocated by multiplying the actual usage by a standard rate.

Note: Under job-order costing, **selling and administrative costs are not allocated** to the products in order to determine the COGS per unit. They are expensed as period costs.

Question 145: Lucy Sportswear manufactures a line of T-shirts using a job-order cost system. During March, the following costs were incurred completing Job ICU2: direct materials, \$13,700; direct labor, \$4,800; administrative, \$1,400; and selling, \$5,600. Factory overhead was applied at the rate of \$25 per machine hour, and Job ICU2 required 800 machine hours. If Job ICU2 resulted in 7,000 good shirts, the cost of goods sold per unit would be:

- a) \$6.50
- b) \$6.30
- c) \$5.70
- d) \$5.50

(CMA Adapted)

Note: On the Exam a numerical question about job-order costing is most likely to be nothing more than a question where you need to use a standard overhead application rate to apply overhead to specific jobs.

Life-Cycle Costing

In life-cycle costing a company does not determine the production cost in the short-term sense of the production of one unit. Rather, the company takes a much longer view to the cost of production and attempts to allocate all of the research and development, marketing, development, after-sale service costs and any other **cost that is associated with this product during its life cycle**. The life cycle of the product may be called its value chain.

This longer-term view is of particular importance when the product has significant research and development (R&D) costs associated with it (or other nonproduction costs such as after sale service costs). For the product to be profitable over its life, these costs also need to be covered by the sales price. If the company fails to take into account the large costs of R&D, it runs the risk of the sales price covering the costs of the actual production of that particular unit, but not the costs of R&D, marketing, after-sales and other costs.

The process of a company looking at all of the costs hopefully enables it to determine the ultimate value of developing a better product. In addition to R&D costs there are also after-sale costs such as warranties and repair work. It may be that a larger investment in the design or development of the product will be recovered through smaller after-sale costs. Or alternatively, the other will be shown and the company may realize that additional design costs will not provide sufficient benefit later to provide a good investment in the early stages.

Note: Life-cycle costing is different from other costing methods because it treats pre-production and after-sale costs as part of the product costs, whereas other methods treat these costs as period expenses that are expensed as incurred. Therefore, under other methods, these pre-production and after-sale costs are not directly taken into account when determining the profitability of a product or product line.

All of the costs in the life cycle of the company can be broken down into three categories. These three categories and the types of costs that are included in them are:

Upstream Costs (before production)

- Research and Development
- Design – prototyping (the first model), testing, engineering, quality development

Manufacturing Costs

- Purchasing
- Direct and indirect manufacturing costs (labor, materials and overhead)

Downstream Costs (after production)

- Marketing and distribution
- Services and warranties

Note: Whole-life costing is similar to life-cycle costing, but also includes after-purchase costs incurred by the customer. Though this is not a cost to the producer, it will be part of the decision-making process by the customer.

Under GAAP financial reporting, the R&D and design costs are expensed as they are incurred. However, for internal decision-making purposes, it is important that the company treat these as product costs that will need to be recovered.

Life-cycle costing plays a role in strategic planning and decision-making about products. After making the life-cycle cost calculations, the company can make an assessment as to whether or not the product should be manufactured. If they believe that they will not be able to charge the required price for the product, then it should not be produced.

Also, by looking at all of the costs that are going to be incurred in the process of developing, producing and selling the product, the company can identify any non-value adding costs, which can then be reduced or eliminated without reducing the value of the product to the customer.

Example: BusinessSoft Co. is about to launch a new product. The company expects a 6-year life cycle from the moment it starts developing this product through its last sale and installation of the product. However, it also expects to provide after-purchase services as part of the contract within and beyond this period.

The company's cost estimates are:

R&D	\$750,000
Design	500,000
Manufacturing costs	300,000
Marketing	200,000
Distribution	100,000
Customer service	250,000
After-purchase support	60,000

The company plans to produce and sell 1,500 installations of the product and would like to earn a 40% mark-up over its life-cycle costs relating to this product. Also, the company envisages that an average client would incur around \$500 of installation, training, operating, maintaining and disposal costs relating to usage of this product. **What is the expected total life-cycle cost per installation for BusinessSoft? And how much do they need to charge per installation?**

Solution: The life-cycle costs to BusinessSoft include all of the upstream, manufacturing and downstream costs related to this product. The upstream costs are the research and development (\$750,000) and the design (\$500,000) costs. Manufacturing costs are \$300,000. Downstream costs include all of the other costs listed above, from marketing to after-purchase support, totaling \$610,000. In total, these manufacturing and downstream costs are \$910,000. In total, the life-cycle costs are **\$2,160,000**.

With a required 40% mark-up over the life-cycle cost, this will require a mark-up of \$864,000 ($\$2,160,000 \times .40$). This means that the total amount that BusinessSoft needs to charge for the 1,500 installations is \$3,024,000, or \$2,016 per installation.

If the company charges **\$2,016 per installation**, it will be able to recover all of the life-cycle costs associated with this product and have a 40% mark-up on those costs.

Note: The costs incurred by the client are relevant only for whole-life costing.

Service Cost Allocation

In almost every company there are departments or employees that are not directly involved in the production process. These **service, or support, departments** incur costs (salary, rent, utilities and so on) that must be transferred to the products that are produced in order to calculate the full cost of production. Common examples of service departments are training, a cafeteria, general maintenance, quality control and power. These costs are essentially the nonmanufacturing overheads. For internal decision-making, the costs of service departments need to be allocated to the **operating, or production, departments** that use their services. The methods of allocating these costs we are about to discuss are different from the ABC Costing method covered above. These costs are being allocated as a cost pool containing all of each department's costs, and the costs are being allocated to user departments on the basis of a single cost driver, such as hours of service used.

Note that this cost allocation, like ABC, does not change the fact that for external financial reporting purposes, the costs of service departments are period expenses and are expensed as they are incurred. The allocation of service costs is strictly an internal function that is used for decision-making, and it is not reflected in the company's external financial statements.

This allocation is done internally because if a company calculates its cost of production but does not include the costs of its service departments, it will calculate a cost of production that is less than the actual total cost. As a result of this incorrect calculation, the company's pricing decisions will not be correct, and in a worst-case scenario, the company may sell the product for less than it actually costs to produce it.

Cost allocations may be done for just one service or support department whose costs are allocated to multiple user departments; or they may be done for multiple service or support departments whose costs are being allocated both to other service/support departments and to other user departments.

Allocating Costs of One Service or Support Department to Multiple Users

Before allocating the costs of a service department to operating departments, management must decide whether the service departments fixed costs and its variable costs should be allocated as one amount, or separately, which would enable the fixed costs to be allocated in a different manner from the variable costs. Allocating the costs as one amount is called the **single-rate method**. Allocating them as two separate cost pools, one consisting of variable costs and one consisting of fixed costs, is called the **dual-rate method**.

- **Single-Rate Method** – The single-rate method does not separate fixed costs of service departments from their variable costs. It puts all of the costs into one cost pool and allocates the costs using one rate per unit of a single allocation base.
- **Dual-Rate Method** – The dual-rate method breaks the cost of each service department into two pools, a variable-cost pool and a fixed-cost pool, and allocates each cost pool using a different cost-allocation base.

Allocation bases for either the single-rate method or the dual-rate method can be:

- 1) **Budgeted rate** and **budgeted hours** to be used by the operating divisions; or
- 2) **Budgeted rate** and **actual hours** used by operating divisions.

Here are examples of the single-rate method and the dual-rate method, using the same data for both.

Example #1: Single-rate method of allocation:

The following information is from the 2010 budget for EZYBREEZY Co. EZYBREEZY has one service department, its Maintenance Department, that serves its Manufacturing and Sales departments. The Maintenance Department has a practical capacity of 5,000 hours of maintenance service available each year. The fixed costs of operating the Maintenance Department (physical facilities, tools) are budgeted at \$247,500 per year. The wages for the maintenance people and the supplies they require are the variable costs, and those are budgeted at \$25 per hour.

Budgeted Maintenance usage by the Manufacturing and Sales departments is as follows:

Manufacturing	3,500 hours
Sales	<u>1,000 hours</u>
Total budgeted usage	4,500 hours

Using a single-rate method, the budgeted total cost pool will be:

$$\$247,500 \text{ fixed cost} + (4,500 \text{ hours} \times \$25) \text{ variable cost} = \$360,000$$

The allocation rate for the total maintenance cost is $\$360,000 \div 4,500 \text{ hours}$, which is \$80 per hour.

The single-rate method is usually used with the second allocation base option: budgeted rate and actual hours used. The actual maintenance hours used by the Manufacturing and Sales departments are as follows:

Manufacturing	3,600 hours
Sales	<u>1,100 hours</u>
Total actual usage	4,700 hours

Therefore, the amounts of Maintenance department costs that will be allocated to the Manufacturing and Sales departments are:

Manufacturing	3,600 × \$80	\$288,000
Sales	1,100 × \$80	<u>88,000</u>
Total cost allocated		\$376,000

The problem with the single-rate method is that, to the user departments, the amount they are charged is a variable amount, even though it includes costs that are fixed. The manager of the Manufacturing department could be tempted to cut his department's costs and outsource the maintenance function, if he could find a company to supply maintenance for less than \$80 per hour.

Suppose an outside maintenance company offers to do the maintenance for the Manufacturing department for \$60 per hour. The amount paid to the outside company will be 3,600 hours @ \$60 per hour, or \$216,000. The Manufacturing department manager is happy, because he has saved \$72,000 (\$288,000 - \$216,000). However, the fixed costs of the in-house Maintenance department do not go away just because Manufacturing is not using their services any longer. The total cost of the Maintenance department (now being used only by the Sales department) will be \$247,500 fixed cost + (1,000 hours × \$25) variable cost = \$272,500. This is \$87,500 less than before (\$360,000 - \$272,500). However, the company has gained an added expense of \$216,000 being paid to the outside maintenance company. So for the company as a whole, total maintenance cost has increased from \$360,000 to \$488,500 (\$272,500 + \$216,000). The Manufacturing department's actions have cost the company as a whole \$128,500.

Example #2: Dual-rate method of allocation:

The following information is from the 2010 budget for EZYBREEZY Co. EZYBREEZY has one service department, its Maintenance Department, that serves its Manufacturing and Sales departments. The Maintenance Department has a practical capacity of 5,000 hours of maintenance service available each year. The fixed costs of operating the Maintenance Department (physical facilities, tools) are budgeted at \$247,500 per year. The wages for the maintenance people and the supplies they require are the variable costs, and those are budgeted at \$25 per hour.

Budgeted Maintenance usage by the Manufacturing and Sales departments is as follows:

Manufacturing	3,500 hours
Sales	<u>1,000 hours</u>
Total budgeted usage	4,500 hours

Because a dual-rate method is being used, EZYBREEZY selects an allocation base for the variable costs and an allocation base for the fixed costs. The company allocates the variable costs based on the **budgeted** variable cost per hour (\$25) and the **actual** hours used. They allocate fixed costs based on **budgeted** fixed costs per hour and the **budgeted** number of hours for each department (option #1).

The actual maintenance hours used by the Manufacturing and Sales departments are as follows:

Manufacturing	3,600 hours
Sales	<u>1,100 hours</u>
Total actual usage	4,700 hours

The allocation rate for the **fixed** cost is $\$247,500 \div 4,500$ hours, or \$55 per hour. The allocation rate for the **variable** cost is \$25 per hour.

The amounts allocated to each user department are now:

Manufacturing:		
Fixed Costs:	$\$55 \times 3,500$ hours	\$192,500
Variable Costs:	$\$25 \times 3,600$ hours	<u>90,000</u>
Total allocated to Manufacturing		\$282,500
Sales:		
Fixed Costs	$\$55 \times 1,000$ hours	\$ 55,000
Variable Costs:	$\$25 \times 1,100$ hours	<u>27,500</u>
Total allocated to Sales		\$ 82,500
Total cost allocated		\$365,000

The total amounts allocated to each user department are different under the dual-rate method and the single-rate method because the fixed costs are allocated based on the **budgeted** usage under the dual-rate method and based on the **actual** usage under the single-rate method.

Under the dual-rate method, the Manufacturing and Sales departments would each be charged for their budgeted fixed allocation even if they do not use the internal Maintenance department. That should discourage the manager of the Manufacturing department from contracting with an outside maintenance service.

The examples above use the **demand** to calculate the allocation rate for the Maintenance Department's costs. The company could instead use the **supply** of service, i.e., the Maintenance department's practical capacity of 5,000 hours to calculate the allocation rate per hour. When the supply is used to calculate the allocation rate and if 100% of the supply is not budgeted for use by user departments, there will be some unused capacity that will not be allocated. However, if unused capacity is caused by one of the user departments having

budgeted for time that it later did not use, the unused resources would still be allocated to that user department.

Using practical capacity to allocate service department costs has the advantage of focusing management's attention on the unused capacity. It also avoids charging user departments with the cost of the unused capacity. When demand is the basis for the allocation, all of the costs of the service department – including the unused capacity – get allocated to the user departments. Charging user departments for unused capacity could cause a **downward demand spiral**. Recall that we defined a downward demand spiral as a continuing reduction in demand that occurs when costs are too high. As demand drops, the cost per unit gets higher and higher, leading to more price increases, which lead to more reduction in demand, and so forth.

Benefits and Costs of the Single-Rate Method

Benefits: The cost to implement it is low because it avoids the analysis needed to classify all of the service department's cost into fixed and variable costs.

Costs: The single-rate method makes fixed costs of the service department appear to be variable costs to the user departments, possibly leading to outsourcing that hurts the organization as a whole.

Benefits and Costs of the Dual-Rate Method

Benefits: It helps user department managers see the difference in the ways that fixed costs and variable costs behave. And it guides user department managers to make decisions that are in the best interest of the organization as a whole, as well as each individual department.

Costs: The cost is higher than the cost of the single-rate method because of the need to classify all of the costs of the service department into fixed and variable costs.

Allocating Costs of Multiple Service or Support Departments

Special cost allocation problems arise when there are several service departments within an organization and the service departments provide support to one another in addition to providing support to operating departments. The factor that complicates the process is service departments using the services of other service departments. For example, people in the maintenance department eat in the cafeteria.

There are three different methods of allocating costs of multiple service departments when they provide services to each other, and all three are simply mathematical allocations, much like the way manufacturing overhead is allocated to the products. The different methods of multiple service cost allocation treat these reciprocal services differently.

The three methods of allocation are:

- 1) The direct method,
- 2) The step (or step-down) method, and
- 3) The reciprocal method.

We will look at each of these in turn.

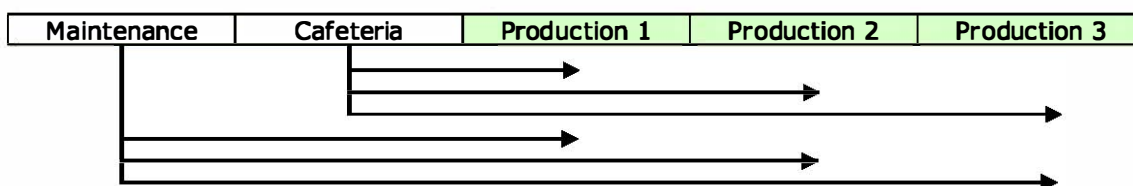
Note: In a question, you should treat the service departments as service departments even if you feel that this should be allocated in a different manner. This may be the case with accounting, for example. In some companies accounting (or other departments) may be expensed and not allocated, but in a question, if accounting is given as a service department, you should treat it as such.

The Direct Method

Under the direct method the reciprocal services that are provided by the different service departments to each other are ignored. The company will simply allocate all of the service departments' costs directly to the production departments. This allocation is made on a basis that is reasonable and hopefully equitable to the production departments. For example, the costs of a cafeteria should be allocated to the production departments based on the number of employees, while the maintenance department may be allocated based on the number of machine hours in the production departments.

When calculating the usage ratios for the different production departments, you **use only the usage of service departments by the production departments**. We do not include the usage in the other service departments, because they will not be allocated any of the costs from other service departments.

This is the simplest and most common method and looks like this.



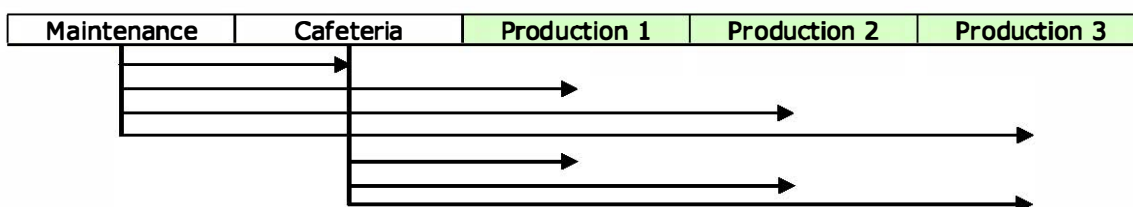
The Step Method

In the step method we attempt to recognize the services that the service departments provide to each other, but we only make one allocation of the costs of each service department. After a particular service department has had its costs allocated, it will not receive any costs from other service departments. This leads to a stair step-like diagram of cost allocations as below.

In order to use this method, there must be an order in which we allocate the costs of the service departments. The order can be any order management chooses. A popular method is to determine the order according to the percentage of each department's services that are provided to other service departments, but that is not the only possible way it is done. The department that provides the highest percentage of its services to other service departments is allocated first. Then the department that provides the next highest percentage of its services to other service departments comes next, and so on.

The first service department will have its costs allocated to the other service departments and the production departments. The second service department's costs (which now include its share of the first service department's costs) will be allocated to the other service departments (but not to the first service department that has already been allocated) and the production departments. Once a service department has had its costs allocated, no costs will be allocated from other service departments to it.

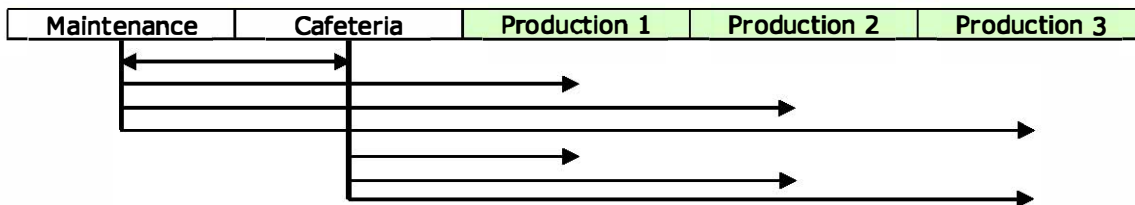
The problem on the Exam will give the allocation order to use if it is not obvious.



Note: In the step method, the costs allocated from the cafeteria include its own incurred costs, plus its portion of the maintenance costs that the cafeteria received. When this allocation of the maintenance department is made, we will use the number of hours that the cafeteria utilized the services of the maintenance department. However, when the cafeteria costs (including the cafeteria's share of the maintenance costs) are allocated, we do not consider the number of people in the maintenance department or their usage of the cafeteria.

The Reciprocal Method

The reciprocal method is the most complicated and advanced of these methods because it recognizes all of the services that are provided by the service departments to the other service departments. Because of this detailed allocation between the service departments, the reciprocal method is the most theoretically correct method to use. However, a company will need to balance the additional costs required in doing this against the benefits that are received. Graphically the reciprocal method looks like this:



To solve a problem using the reciprocal method, "simultaneous" or multiple equations must be used. The multiple equations will be set up this way (this is for a situation in which there are two service departments).

Maintenance Costs to Allocate = \$ amount of Maintenance costs + their % of Cafeteria costs

Cafeteria Costs to Allocate = \$ amount of Cafeteria costs + their % of Maintenance costs

We can then solve for either "Maintenance Costs to Allocate" or "Cafeteria Costs to Allocate," and then solve for the other number. These calculated amounts become the amount that needs to be distributed from the maintenance department or cafeteria to all other departments, including the other service departments.

The process of solving the two equations is shown in detail in the example on the following pages.

Comprehensive Example of Direct, Step and Reciprocal Methods

Example: We will use the following information about Cubs Co. to demonstrate the different methods of allocating service costs. Cubs has two service departments (A and B) and three production departments (X, Y and Z). Service Department A will allocate its overhead based on direct labor hours and Service Department B will allocate its overhead based on machine hours. The following information is in respect to the service and production departments:

	<u>Dept A</u>	<u>Dept B</u>	<u>Dept X</u>	<u>Dept Y</u>	<u>Dept Z</u>	<u>Total</u>
Overhead	\$100,000	\$50,000	\$200,000	\$300,000	\$250,000	\$900,000
Labor Hours	--	1,000	2,000	4,000	3,000	10,000
Machine Hours	2,000	--	2,000	2,000	2,000	8,000

Direct Method

Under the direct method each service department will allocate costs only to the production departments. For Department A, the production departments used a total of 9,000 (2,000 + 4,000 + 3,000) labor hours, so each department will receive \$11.11 (\$100,000 ÷ 9,000) for each of their labor hours. After being allocated to each production department, the production department will further allocate this to the individual units in its department. Department B provided 6,000 (2,000 + 2,000 + 2,000) machine hours of service to the production departments, so they will allocate \$8.33 (\$50,000 ÷ 6,000) per machine hour to the production departments. We ignore the services that were provided to the other service departments in this calculation.

Now we can determine how much of the costs of the service departments will be allocated to Department Y. First, we will allocate costs of Department A. Department Y used 4,000 labor hours of Department A: \$11.11 per hour × 4,000 hours = \$44,440. Department Y also used 2,000 machine hours of Department B: \$8.33 per hour × 2,000 hours = \$16,660. Adding these numbers together, Department Y will be allocated \$61,100 (\$44,440 + \$16,660) of the costs incurred by Departments A and B.

Step Method

Under the step method we must determine which service department will be allocated first. We can calculate that 25% of the service provided by Department B was to Department A. Since only 10% of Department A's service was to Department B, we will allocate Department B first. In total, B provided 8,000 machine hours of service, 25% of which was to Department A. So, A will receive 25% of B's overhead, or \$12,500. This \$12,500 is then added to the \$100,000 of A's own overhead, giving a total \$112,500. This will then be allocated only to the production departments based on the direct labor hours. This allocation is the same as in the direct method, except that there are now more costs to allocate from Department A because some costs of Department B are included.

Now we can determine how much of the service department costs to allocate to Department Y. First, we will allocate costs of Department A (\$112,500 in total as calculated above). The rate per hour for Department A is \$12.50 (\$112,500 ÷ 9,000). Department Y used 4,000 hours of Department A so it will be allocated \$50,000 (4,000 × \$12.50) from Department A. The cost per machine hour in Department B is \$6.25 (\$50,000 ÷ 8,000). Department Y used 2,000 machine hours, so \$12,500 (2,000 hours × \$6.25 per hour) will be allocated to Department Y from Department B. Adding these numbers together we get \$62,500 (\$50,000 + \$12,500).

Reciprocal Method

Under the reciprocal method we will allocate some of Department A to Department B and some of Department B to Department A, which is done using simultaneous equations. Since there are two departments we need to use two equations. (If there were three departments we would need three equations, but since that is unlikely to appear on the Exam, it is not covered here.) These equations will solve how much each service department needs to allocate to all of the departments, including the other service departments.

The equations we need are:

$$A = \$100,000 + .25B$$

$$B = \$50,000 + .1A$$

We solve for Dept A by substituting the second equation into the first for the variable B.

$$A = \$100,000 + .25 (\$50,000 + .1A)$$

Now we have only one variable in the equation and we can solve for Dept A.

$$A = \$100,000 + \$12,500 + .025A$$

$$.975A = \$112,500$$

$$A = \$115,384.62$$

Now that we have solved for A, we can put this into the second equation and solve for B.

$$B = \$50,000 + .1 (\$115,384.62)$$

$$B = \$61,538.46$$

We now know how much overhead needs to be allocated by Departments A and B to all of the other departments, including the service departments. This allocation is done below:

	<u>Dept A</u>	<u>Dept B</u>	<u>Dept X</u>	<u>Dept Y</u>	<u>Dept Z</u>
Own Overhead	\$100,000.00	\$50,000.00	\$200,000.00	\$300,000.00	\$250,000.00
Allocated from A	(115,384.62)	11,538.46	23,076.92	46,153.85	34,615.39
Allocated from B	<u>15,384.62</u>	<u>(61,538.46)</u>	<u>15,384.62</u>	<u>15,384.62</u>	<u>15,384.62</u>
Total OH	\$ 0.00	\$ 0.00	\$238,461.54	\$361,538.46	\$300,000.00

Notice that the total amount of overhead in the production departments is now equal to the total amount of overhead that the company incurred during the period (\$900,000). This will now need to be allocated to the products that were made in the production departments.

The following information is for the next five Questions: The managers of Rochester Manufacturing are discussing ways to allocate the cost of support departments such as Quality Control and Maintenance to the production departments. To aid them, they were provided the following information:

	<u>Quality Control</u>	<u>Maintenance</u>	<u>Machining</u>	<u>Assembly</u>	<u>Total</u>
Budgeted overhead costs before allocation	\$350,000	\$200,000	\$400,000	\$300,000	\$1,250,000
Budgeted machine hours	--	--	50,000	--	50,000
Budgeted direct labor hours	--	--	--	25,000	25,000
Budgeted hours of service:					
Quality Control	--	7,000	21,000	7,000	35,000
Maintenance	10,000	--	18,000	12,000	40,000

Question 146: If Rochester uses the direct method of allocating support department costs, the total support costs allocated to the Assembly Department would be:

- a) \$80,000
- b) \$87,500
- c) \$120,000
- d) \$167,500

Question 147: If Rochester uses the direct method, the total amount of overhead allocated to each machine hour at Rochester would be:

- a) \$2.40
- b) \$5.25
- c) \$8.00
- d) \$15.65

Question 148: If Rochester uses the step-down method of allocating support costs beginning with quality control, the maintenance costs allocated to the Assembly Department would be:

- a) \$70,000
- b) \$108,000
- c) \$162,000
- d) \$200,000

Question 149: If Rochester uses the reciprocal method of allocating support costs, the total amount of quality control costs to be allocated to the other departments would be:

- a) \$284,211
- b) \$336,842
- c) \$350,000
- d) \$421,053

Question 150: If Rochester decides not to allocate support costs to the production departments, the overhead allocated to each direct labor hour in the Assembly Department would be:

- a) \$3.20
- b) \$3.50
- c) \$12.00
- d) \$16.00

(CMA Adapted)

Estimating Fixed Costs

Sometimes costs are mixed costs or the fixed costs are not segregated from the variable costs in the historical information available. When we need to separate fixed costs from variable costs for analysis, budgeting or costing purposes, there are two methods that can be used: the High-Low Points Method and Regression Analysis.

High-Low Points Method

For the High-Low Points Method, we use the highest and lowest observed values of the cost driver within the relevant range.

If, for example, we need to segregate fixed production costs from variable production costs and all we have is a single total cost amount, we will take the month of the highest level of production or usage and the month of the lowest level of production or usage. By comparing the differences in production with the differences in total costs between these two months, we can determine approximately what amount of the costs are variable and what amount are fixed. The steps to calculate this are the following:

- 1) Calculate the Variable Cost Per Unit by dividing the difference between the highest and lowest costs by the difference between the highest and lowest production volumes:

$$\frac{\text{Difference in Costs}}{\text{Difference in Units}} = \text{Variable Cost per Unit}$$

This calculation gives us the variable cost per unit. We know this because the difference in costs between the two months is related only to variable costs (since we are assuming that all other costs are fixed and therefore unchanging with changes in production volume).

- 2) Multiply the Variable Cost per Unit by the unit volume at either the highest or the lowest production volume to get the total variable cost at that level.
- 3) Subtract the total variable cost from the total cost at that level to get the fixed cost.

Another way of estimating the variable cost per unit using the High-Low Points method is to set up two equations in two variables, with one equation representing the highest level and one equation representing the lowest level. The two variables are Fixed Costs and Variable Costs. Then, subtract one equation from the other equation to eliminate the Fixed Cost as a variable and solve the remainder for the Variable Cost.

Both methods are illustrated using the same data in the following examples:

Example: Ray Corporation experienced the following total production costs during the past year at the following monthly levels of production:

Ray Corporation Production Volumes and Costs		
	<u>Production in Units</u>	<u>Total Production Costs</u>
January	6,257,000	\$1,500,000
February	4,630,000	1,200,000
March	5,200,000	1,300,000
April	5,443,000	1,350,000
May	5,715,000	1,400,000
June	3,000,000	900,000
July	3,543,000	1,000,000
August	3,815,000	1,050,000
September	5,715,000	1,400,000
October	6,800,000	1,600,000
November	6,529,000	1,550,000
December	5,172,000	1,300,000

What is Ray Corporation's Fixed Cost and what is its Variable Cost per Unit?

The highest and the lowest values are:

	<u>Production in Units</u>	<u>Total Production Costs</u>
October	6,800,000	\$1,600,000
June	3,000,000	900,000

Using the first method to estimate the variable cost per unit:

$$\frac{\text{Difference in Costs}}{\text{Difference in Units}} = \frac{\$700,000}{3,800,000} = \$0.1842105 \text{ variable cost/unit}$$

Using the second method (two equations) to estimate the variable cost per unit:

$$\begin{array}{rcl} \text{FC} + 6,800,000 \text{ VC} & = & \$1,600,000 \\ - \text{FC} + 3,000,000 \text{ VC} & = & 900,000 \\ \hline 0 + 3,800,000 \text{ VC} & = & \$700,000 \\ \text{VC} & = & \$0.1842105 \end{array}$$

Whichever way we choose to calculate the Variable Cost per Unit, the next step is to put the Variable Cost per Unit into an equation to calculate Fixed Cost. For this step, we can use either the lowest or the highest volume-cost equation. Here we will use the highest.

$$\begin{aligned} \text{FC} &= \text{Total Cost} - \text{Variable Cost} \\ \text{FC} &= \$1,600,000 - (6,800,000 \times 0.1842105) = \underline{\underline{\$347,369}} \end{aligned}$$

We can prove this Fixed Cost amount by putting it into the equation for the lowest point values:

$$\$347,369 + (3,000,000 \times 0.1842105) = \$900,000$$

So Fixed Cost is \$347,369, and Variable Cost is \$0.1842105 per unit.

Regression Analysis

Simple regression analysis can also be used to find the fixed cost and the variable cost per unit when you have an independent variable such as production in units and a dependent variable such as total production costs. We used it in the section on Forecasting to graph a trend line and extend that trend line out to create a forecasted sales amount based on the previous trend. There, we were using simple regression analysis with a time series, where time was the independent variable and sales volume was the dependent variable.

However, simple regression analysis can also be used to analyze a set of data where time is not the independent variable but rather, something else is the independent variable. When we use regression analysis to estimate fixed and variable costs as in this example, production in units is the independent variable and total production costs is the dependent variable. Although we have several sets of X and Y data and each set of data represents activity for a specific month, this regression analysis will not have the months on the X axis. For the purpose of this analysis, it makes no difference which month each set of data occurred in. What is important is the relationship of the dependent variable (production costs) to the independent variable (production volume) for each month. As we will see, it is very consistent. And because it is consistent, it can be used to predict what fixed costs and variable costs will be in any future month based on what we predict production volume will be in that month.

Regression analysis can be done in Excel using the Data Analysis ToolPak Add-In. This add-in must be loaded into Excel before it will be accessible. Loading it is done differently depending upon which version of Excel you have. If it is not loaded, you can get directions for loading it by searching the Help directory in your Excel program for "Load or Unload Add-In Programs."

When the Data Analysis Toolpak Add-In has been loaded, enter the input into a blank spreadsheet. Here is the data from the Ray Corporation example on the preceding page as it would appear in an Excel spreadsheet (formatting is not important). The independent variable (production in units) is in Column A and the dependent variable (total production costs) is in Column B. You can give headings to the data if you wish, but if you do, do not include the cells containing the headings in the ranges to be analyzed.

	A	B
1	6257000	1500000
2	4630000	1200000
3	5200000	1300000
4	5443000	1350000
5	5715000	1400000
6	3000000	900000
7	3543000	1000000
8	3815000	1050000
9	5715000	1400000
10	6800000	1600000
11	6529000	1550000
12	5172000	1300000

Then launch the Data Analysis ToolPak. In the analysis tools available, choose "Regression." In the dialogue box that comes up,

- 1) Enter the dependent variable range into the field "Input **Y** Range." In our example, the dependent variable is in column B, so the range is \$B\$1:\$B\$12.
- 2) Enter the independent variable range into the field "Input **X** Range." In this example, the independent variable is in column A, so the range is \$A\$1:\$A\$12.
- 3) For "Output Options," choose "New Worksheet **P**ly:"
- 4) Click OK.

Note: This example was created in the Windows version of Excel 2007; another version of Excel might be slightly different.

A new sheet will be created in your workbook. The new worksheet will look like this:

SUMMARY OUTPUT								
<i>Regression Statistics</i>								
Multiple R	0.999977007							
R Square	0.999954015							
Adjusted R Square	0.999949417							
Standard Error	1571.852533							
Observations	12							
<i>ANOVA</i>								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	1	5.37267E+11	5.37267E+11	217453.5664	5.0603E-23			
Residual	10	24707203.85	2470720.385					
Total	11	5.37292E+11						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>tStat</i>	<i>P-value</i>	<i>Lower95%</i>	<i>Upper 95%</i>	<i>Lower95.0%</i>	<i>Upper 95.0%</i>
Intercept	346902.0628	2084.915328	166.3866432	1.51077E-18	342256.582	351547.5436	342256.582	351547.5436
X Variable 1	0.184201867	0.000395012	466.319168	5.0603E-23	0.183321725	0.18508201	0.183321725	0.18508201

The four pieces of information you need from this spreadsheet are highlighted in the sheet above.

- The **coefficient of correlation** is called "**Multiple R**" on this spreadsheet, and it is 0.999977007. This is about as close to 1 as you can get, and it indicates a very strong correlation between production volume and production costs. The coefficient of correlation is explained in detail in this book in the section on Forecasting.
- The **coefficient of determination**, called "**R square**" on this spreadsheet, is the square of the coefficient of correlation. It is 0.999954015. The coefficient of determination indicates the percentage of the total amount of change in the dependent variable (production costs) that can be explained by changes in the independent variable (production volume). The coefficient of determination is also explained in the section on Forecasting. If necessary, you should go back and reread about both the coefficient of correlation and the coefficient of determination so that you understand what these coefficients mean. (Hint: In this example, they tell us that any estimate of fixed and vari-

able costs that we make for any given production level based on this regression should be quite accurate. But make sure you understand why that is true.)

- The amount of the fixed cost is the **constant coefficient**, or the **Y-intercept**, which is \$346,902.0628.
- The variable cost per unit is the **variable coefficient**, or **X variable**, which is \$.184201867 per unit.

Note how similar this result is to the result we got when we analyzed the same data using the High-Low Points Method. With the High-Low Points Method, the fixed cost was \$347,369 and the variable cost was \$.1842105 per unit.

Operational Efficiency

Just-in-Time (JIT) Inventory Management Systems

Just-In-Time inventory management systems are based on a manufacturing philosophy that combines purchasing, production and inventory control into one function. The goal of a JIT system is to minimize the level of inventories that are held in the plant at all stages of production, including raw materials, work-in-process and finished goods inventories.

The advantage of a JIT system is reduction in the cost of carrying the inventory. The cost savings include reduction in the risk of damage, theft, loss, or a lack of ability to sell the finished goods.

One of the main differences between JIT and traditional inventory systems is that JIT is a **"demand-pull system"** rather than a **"push system."** In a push system, a department produces and sends all that it can to the next step for further processing, which means that the manufacturer is producing something without understanding consumer demand. This can result in large, useless stocks of inventory. The main idea of JIT is that nothing is produced until the next process in the assembly line needs it. Ultimately, this means essentially that nothing will be produced until a customer orders it, and then it will be produced very quickly. This demand-pull feature requires close coordination between workstations. Close coordination between workstations can keep the flow of goods smooth in spite of the low levels of inventory.

The goal of a JIT system is to

- 1) Meet customer demand in a timely manner,
- 2) With high-quality products, and
- 3) At the lowest possible cost.

This means essentially that nothing will be produced until a customer orders it. By contrast, in a push system, a department produces all that it can and sends those units to the next step in the process for further processing. This means that a company is producing something without knowing if it is actually needed or not, resulting in a possibly large, useless stock of inventory.

To implement the JIT approach and to minimize inventory storage, the factory must be reorganized to permit what is known as **lean production**. Under lean production, the plant layout is arranged by **manufacturing cells** or **work cells**. Each work cell produces a product or product type. Each worker in each cell knows how to operate all the machines in that cell and can perform supporting tasks within that cell. This reduces the downtime resulting from breakdowns or employee absences.

Elimination of defects is an important part of a JIT system. Because of the close coordination between and among workstations and the minimum inventories held at each workstation, defects caused at one workstation very quickly affect other workstations. JIT requires that problems and defects be solved by eliminating their root causes as quickly as possible. Since inventories are low, workers are able to trace problems to their source and resolve them at the point where they originated.

Because inventory levels are kept low in a JIT system, the company must have a very close relationship with its suppliers to make certain that the supplier makes frequent deliveries of smaller amounts of inventory. In a JIT system, inventory is purchased so that it will be delivered just as needed for production (or just as needed for sales, if the company is a reseller instead of a manufacturer). It is also critical that the inventory is of the required quality because there is no extra to use in place of any defective units that are delivered. Because very little inventory is held, a supplier that does not deliver direct materials on time, or delivers direct materials that do not meet quality standards can cause the company to not be able to meet its own scheduled deliveries. Therefore, a company that uses JIT purchasing must choose its suppliers carefully and maintain long-term supplier relationships.

In addition to the advantage of lower carrying costs for inventory, other benefits of a JIT system include greater emphasis on improving quality by eliminating the causes of rework, scrap and waste. Setup times are decreased, which makes production of smaller batches more economical. This in turn reduces inventory levels

and enables the company to respond quickly to changes in customer demand. The reduced setup time also leads to lower manufacturing lead times.

Furthermore, JIT systems typically require less floor space than traditional factories do for equal levels of production because they do not need to store large amounts of inventories. Reductions in square footage can reduce energy use for heating, air conditioning, and lighting. Even more importantly, reducing the needed floor space can reduce the need to construct additional production facilities, reducing the need for capital investment and the associated environmental impacts that result from construction material use, land use, and construction waste.

Just-in-time production also has costs and shortcomings. The reduced level of inventory carries with it an increased risk of stockout costs and can lead to more frequent trips for parts and material inputs from sister facilities or suppliers. This can contribute to traffic congestion and environmental impacts associated with additional fuel use and additional vehicle emissions. If the products produced have large and/or unpredictable market fluctuations, a JIT system may not be able to reduce or eliminate overproduction and associated waste. And JIT implementation is not appropriate for high-mix manufacturing environments, which often have thousands of products and dozens of work centers.

Kanban

Kanban is a Japanese inventory system. The word “kanban” means “card” or “sign” or “visual record” in Japanese. Kanban is an integral part of a JIT system. Kanban provides the physical inventory control cues that signal the need to move raw materials from the previous process.

The core of the Kanban concept is that the supplier delivers components to the production line on an “as needed” basis, signaled for example by receipt of a card and an empty container, thus eliminating storage in the production area. This is a chain process where orders flow from one process to another, so production of components is pulled to the production line, rather than pushed (as is done in the traditional forecast-oriented system).

A kanban can be a card, a labeled container, a computer order, or some other device that is used to signal that more products or parts are needed from the previous production process. The kanban contains information on the exact product or component specifications that are needed for the next process. Reusable containers may serve as the kanban, assuring that only what is needed gets produced.

Kanban are used to control work-in-process (WIP), production, and inventory flow. In this way, kanban serves to eliminate overproduction.

The major kanban principles are:

- **Kanban works from upstream to downstream in the production process** (i.e., starting with the customer order). At each step, only as many parts are withdrawn as the kanban instructs, helping ensure that only what is ordered is made. The necessary parts in a given step always accompany the kanban to ensure visual control.
- **The upstream processes produce only what has been withdrawn.** This includes producing items only in the sequence in which the kanban are received, and producing only the number indicated on the kanban.
- **Only products that are 100 percent defect-free continue on through the production line.** In this way, each step recognizes and corrects the defects that are found before any more can be produced.
- **The number of kanban should be decreased over time.** Minimizing the total number of kanban is the best way to uncover areas of needed improvement. By constantly reducing the total number of kanban, continuous improvement is facilitated by concurrently reducing the overall level of stock in production.

Different types of kanban include supplier kanban (orders given to outside parts suppliers when parts are needed for assembly lines); in-factory kanban (used between processes in the factory); and production kanban (indicating operating instructions for processes within a line).

It should be mentioned that Kanban can go beyond being a simple JIT technique because it can also support industrial reengineering and HR management.

Example: The Saturn Site in Spring Hill, TN, consists of three plants – Powertrain, Body and Assembly. The site covers 4.3 million sq. ft. and has a total of approximately 10,000 operations such as stamping, molding, fabrication, casting, machining, assembly, fluid fill, and so on. Saturn brings these operations together in an integrated manufacturing system designed around just-in-time principles.

Processes and Buffers

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Materials Requirements or Material Resource Planning (MRP)

Materials requirements planning (MRP, also known as material resource planning) is an approach that uses computer software to help manage a manufacturing process. It is a system for ordering and scheduling of **dependent demand inventories**.

Dependent demand is demand for items that are components, or subassemblies, used in the production of a finished good. The demand for them is **dependent** upon the demand for the finished good.

MRP is a “**push**” inventory management system. Finished goods are manufactured for inventory on the basis of demand forecasts. MRP makes it possible to have the needed materials available when they are needed and where they are needed.

When demand forecasts are made by the sales group, the MRP software breaks out the finished products to be produced into the required components and determines total quantities to be ordered of each component and when each component should be ordered, based upon information about inventory of each component already on hand, vendor lead times and other parameters that are input into the software.

Once the quantities and the timing have been worked out, the required cash to pay for the parts can be planned for. MRP can be used to reduce cash needed by the organization, which in turn improves profitability and ROI. MRP creates the antithesis of the situation often found in old manufacturing organizations where large amounts of cash are tied up in inventory before products can be assembled and sold. Instead, MRP aims to remedy this through careful planning and management.

Although MRP is a push inventory system, it can also be used in a “demand-pull” situation, if an unexpected order is received, to determine the components to be purchased and when each should be purchased in order to produce the special order as efficiently and quickly as possible using Just-In-Time (JIT) inventory management techniques.

MRP and Making Calculations in Manufacturing

MRP uses the following information in order to determine what outputs will be necessary at each stage of production and when to place orders for each needed component:

- Demand forecasts for finished goods;
- A **Bill of Materials** for each finished product. The Bill of Materials gives all the materials, components, and subassemblies that are required for the product;
- The quantities of the materials, components, and finished products inventory presently on hand.

Although MRP is done by computers, it is important to know how the software does its work in order to be certain that the output from the MRP software is correct and to troubleshoot problems. Correct output depends upon correct input, and it is necessary to understand how the inputted information is used in order to make sure the software is working correctly. For that reason, we do simple examples by hand.

The best way to explain how MRP works is to give an example.

Question 151: Which of the following statements about a just-in-time system is/are true?

- a) To prepare for fulfilling orders from existing and prospective customers, it is important to maintain high levels of inventory at all times.
- b) A just-in-time system is a push system.
- c) The company’s plant layout must center around supporting mass production.
- d) Cost reduction is an important factor.

(HOCK)

Example of MRP Calculations

MRP Industries manufactures widgets. The sales department has forecast sales of 1,000 widgets for next month. The following parts go into the manufacture of one widget:

Part No. A1 – 2

Part No. C2 – 1

The following parts go into the manufacture of one Part No. A1:

Part No. B6 – 1

Part No. F3 – 2

The following parts go into the manufacture of one Part No. B6:

Part No. C2 – 2

Part No. E7 – 1

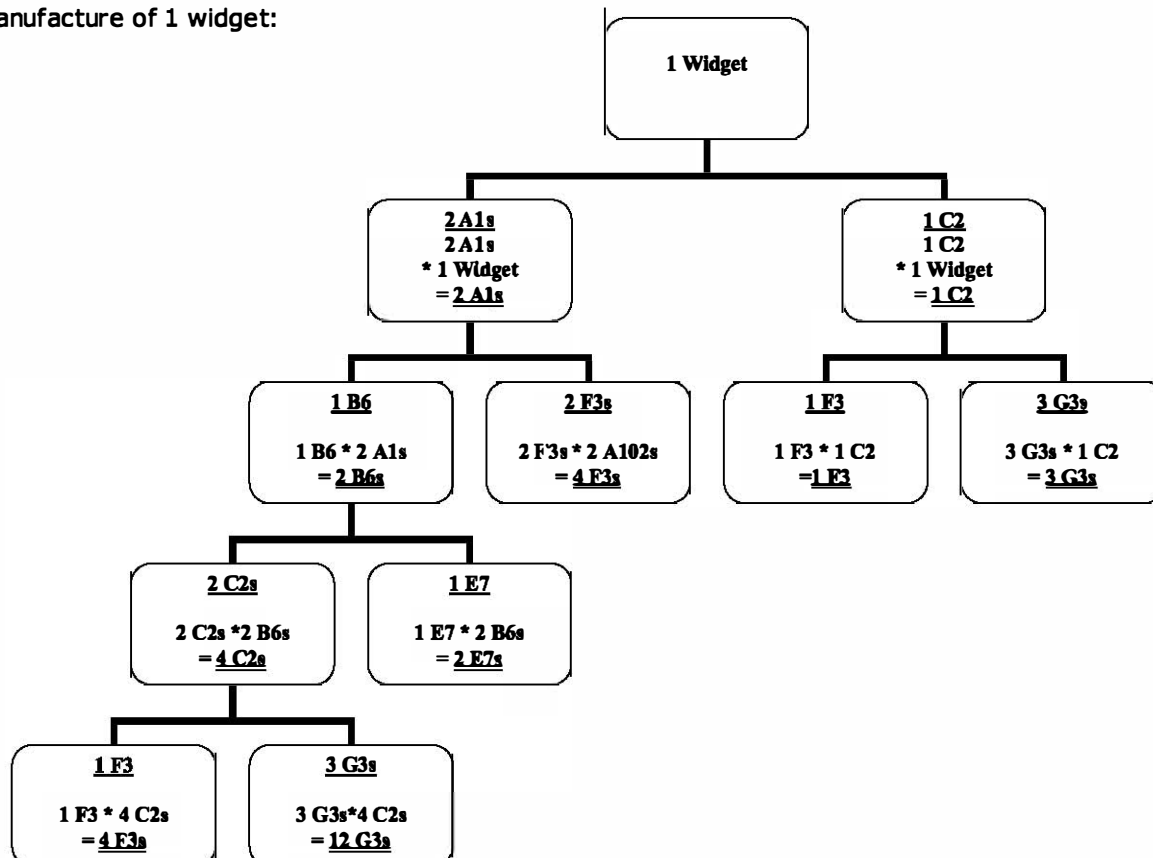
The following parts go into the manufacture of one Part No. C2:

Part No. F3 – 1

Part No. G3 – 3

Part Nos. E7, F3 and G3 are purchased components, not manufactured components.

Here is a chart depicting the information above of all the components and subassemblies that go into the manufacture of 1 widget:



Adding up the number of components and subassemblies that will be needed to manufacture 1 widget, we get (verify this by looking at the chart above):

Part No. G3: $12 + 3 = 15$ (purchased)

Part No. F3: $4 + 4 + 1 = 9$ (purchased)

Part No. C2: $4 + 1 = 5$ (manufactured from 5 F3s and 15 G3s, both parts purchased)

Part No. E7: 2 (purchased)

Part No. B6: 2 (manufactured from 4 C2s and 2 E7s. The 4 C2s are manufactured from 4 F3s and 12 G3s, both purchased. The 2 E7s are purchased.)

Part No. A1: 2 (manufactured from 2 B6s and 4 F3s. The B6s are manufactured from 4 C2s and 2 E7s. The 4 C2s are manufactured from 4 F3s and 12 G3s, both parts purchased. The 2 E7s are purchased.)

Therefore, the total number of **purchased parts** needed is:

Part No. G3 – $15 \times 1,000$ widgets to be manufactured = 15,000

Part No. F3 – $9 \times 1,000$ widgets to be manufactured = 9,000

Part No. E7 – $2 \times 1,000$ widgets to be manufactured = 2,000

The MRP software will schedule when these parts should be ordered, based upon when they are needed in the manufacturing, each vendor's lead time required, and each vendor's pricing. For example, 12,000 G3s will be needed at the beginning of the manufacturing process and 3,000 more G3s will be needed near the end of the process. The MRP software will determine whether it is more economical to purchase all 15,000 G3s at the same time or whether it is more economical to purchase 12,000 on one date and 3,000 at a later date.

Furthermore, the inventory already on hand of each required part to be purchased and to be manufactured is input into the MRP software or calculated by it, and the amounts of parts to be purchased will be decreased for parts already on hand, both parts to be purchased that are on hand and parts already manufactured that are on hand.

A chart like the one above can be used to calculate the number of components and subassemblies that will be needed for any manufacturing job. You may be asked on the exam to calculate the number of subunits needed for a particular manufacturing job, so be familiar with the way the chart works.

Outsourcing

When a company outsources, an external company performs one or some of its internal functions. By outsourcing certain functions to a specialist, management can free up resources within the company in order to focus on the primary operations of the company. It may also be cheaper to outsource a function to a company that specializes in an area than it is to run and support that function internally. The disadvantage of outsourcing is that the company loses direct control over these functions.

Theory of Constraints (TOC)

Theory of Constraints (TOC) is a means of making decisions at the operational level that will impact a company's profitability positively. For a company to be competitive, it needs to be able to respond quickly to customer orders. Theory of Constraints is an important way for a company to speed up its manufacturing time so it can improve its customer response time and its profitability.

Manufacturing cycle time, also called **manufacturing lead time** or **throughput time**, is defined as the amount of time between the receipt of a customer order and the shipment of the order.

Theory of Constraints can be used to decrease a company's manufacturing cycle time and its costs. If a company is **not** using TOC, management could be devoting its time to improving efficiency and speed in all areas of the manufacturing process equally. But TOC says that managers should focus their attention only on areas that are **constraints** or **bottlenecks**. **Constraints** are the activities that slow down the product's total cycle time, while areas and people performing other activities have slack time. If managers spend their time and effort speeding up activities that are not constraints, they are wasting resources. Unnecessary efficiency just results in the buildup of work at the constraint and before it, while activities following the constraint do not have enough work to do because work is held up in the constraint process. Total production speed is not improved despite the extra cost incurred to improve efficiency. Managers' time and effort and the associated cost should be spent on speeding up the activities that cause production to slow down.

Theory of Constraints says that constraint processes are the only areas where improvements in their performance will bring about a meaningful change in overall profitability. If you want to improve profitability, you need to identify the constraints and focus on them. Theory of Constraints focuses on measurements that are linked directly to performance measures such as net profit, return on investment, and cash flow. It gives managers a method of making decisions on a day to day basis that will truly affect the overall performance of the organization.

As we have already mentioned, **throughput time**, or **manufacturing cycle time**, is the time that elapses between the receipt of a customer order and the shipment of the order. Throughput time is a **rate**. It is the rate at which units can be produced and shipped. For example, if it takes 2 days to produce and ship 100 units, then the rate per day is 50 units per day.

Throughput contribution margin is the rate at which **contribution margin dollars** are being earned. Throughput contribution margin is the revenue earned from the sale of units minus the totally variable costs only (usually only direct materials) for those units produced during a given period of time. If the sale price for one unit is \$500, the direct materials cost is \$300 per unit, and throughput rate per day is 50 units per day, then the **throughput contribution margin per day** is $\$200 \times 50 = \$10,000$. Or, calculated another way, if 50 units can be produced and shipped in one 8-hour day, then it takes $8 \text{ hours} \div 50$, or .16 of one hour, to produce and ship one unit. $\$200 \div .16 = \$1,250$ per hour. In an 8-hour day, throughput contribution margin is $\$1,250 \times 8$, or \$10,000. Throughput contribution margin is the amount earned for product produced and shipped during one hour, one day, one month, etc., calculated using revenue minus only the strictly variable costs.

Following are the steps in managing constraint operations through the use of TOC analysis:

- 1) **Identify the constraint.** Recognize that the constraint or bottleneck operation determines the throughput contribution margin of the system as a whole, and identify the constraint by determining where total required hours exceed available hours. To identify where slack hours exist and where they are negative because total required hours exceed available hours, analysis of the production process is prepared. The management accountant works with manufacturing managers and engineers to develop a **flow diagram** that shows the sequence of processes, the amount of time each process requires given current demand levels, and the amount of time available in terms of labor hours and machine hours. The flow diagram enables them to identify the constraint.
- 2) **Determine the most profitable product mix given the constraint.** The most profitable product mix is the combination of products that maximizes total profits. Product profitability is measured using the **throughput contribution margin**. The throughput contribution margin is the product price less materials cost, including the cost of all materials used, all purchased components, and all materials-handling costs. Direct labor and other manufacturing costs such as overhead are excluded, because it is assumed they will not change in the short term. The throughput contribution margin of each product is divided by the number of minutes required for one unit at the constraint to calculate the **throughput contribution margin per minute per unit in the constraint activity** for each

product. The product with the highest throughput contribution margin per minute in the constraint will be the most profitable, even though it may have a lower throughput contribution margin.

- 3) **Maximize the flow through the constraint.** The management accountant looks for ways to simplify the constraint process, reduce setup time, or reduce other delays due to non-value-added activities such as machine breakdowns, in order to speed the flow through the constraint.

The **drum-buffer-rope (DBR) system** is a tool that can be used to balance the flow of production through the constraint. It minimizes the buildup of excess inventory at the constraint, while at the same time keeping it producing at all times. All production flows are synchronized to the **drum** (the constraint), which provides the beat that sets the pace for the whole production process. The **rope** consists of all of the processes that precede and include the constraint, which remember is called the drum. Activities preceding the drum are carefully scheduled so that they do not produce more output than can be processed by the constraint, because this creates excess inventory and its associated costs without increasing throughput contribution margin. But at the same time, the constraint must be kept working with no down time. The **buffer** is a minimum amount of work-in-process inventory (a "buffer" inventory) of jobs waiting for the constraint that is maintained to make sure the constraint process is kept busy at all times. Since production schedules are planned so that workers in the non-constraint processes will not produce any more output than can be processed by the constraint process, the constraint process sets the pace for the whole production process, which is the reason it is called the **drum**.

- 4) **Add capacity to the constraint.** Increase the production capabilities of the constraint by adding capacity such as additional equipment and/or labor, which is a longer-term measure to consider if it is possible and profitable to do so.
- 5) **Redesign the manufacturing process for flexibility and fast cycle time.** Analyze the system to see if improvements can be made by redesigning the manufacturing process, introducing new technology, or revising the product line by eliminating hard-to-manufacture products, or by redesigning products so they can be manufactured more easily. This is the most strategic response to the constraint.

When the Theory of Constraints is applied to production, it is a technique that improves speed in manufacturing by **increasing throughput contribution margin** while **decreasing investments** and **decreasing operating costs**. Throughput (product produced and shipped) will be maximized, investments will be minimized, and operating costs will be minimized. TOC helps reduce throughput time, or cycle time, and therefore operating costs. And with TOC there is a lower overall level of inventory, so inventory investment is decreased.

In TOC terms, **investments** equals the sum of costs in direct materials, work-in-process and finished goods inventories; R&D; and costs of equipment and buildings. **Inventory costs** are limited to costs that are **strictly variable**, called "**super-variable**," and these are usually **only direct materials**. (Note: this does not mean that absorption costing for external financial reporting purposes is done differently when TOC is being used. It means only that inventory costs for internal TOC analysis purposes are different from inventory costs for financial reporting purposes.)

Operating costs are equal to all operating costs other than direct materials or any other strictly variable costs incurred to earn throughput contribution margin. Operating costs include salaries and wages, rent, utilities and depreciation. **All** employee costs are considered operating costs, whether it is direct labor or indirect labor. **Direct labor does not go into the calculation of throughput contribution margin, and thus it is considered an operating cost.**

When work is properly scheduled, the constraint will achieve its maximum performance without interruptions. The material is released only as needed without building up unneeded material (inventory) at the non-bottleneck resources. This enables the factory to achieve optimal performance.

- **Throughput** is product produced and shipped.
- **Throughput time** or **manufacturing cycle time** is the time that elapses between the receipt of a customer's order and the shipment of the order.
- **Throughput contribution margin** is revenue minus direct materials cost for a given period of time.
- **Only strictly variable costs – which are usually only direct materials – are considered inventory costs.** All other costs, even direct labor, are considered operating, or fixed, costs.
- **Theory of Constraints assumes that operating costs are fixed costs** because it regards them as difficult to change in the short run.
- **Theory of Constraints focuses on short-run maximization of throughput contribution margin** by managing operations at the constraint in order to improve the performance of production as a whole.

Some ways that operations at the constraint process can be relieved include:

- 1) Eliminate idle time at the constraint operation. For example, perhaps hiring an additional employee to work at the constraint operation would increase throughput at the constraint by 2,000 units per year at an annual cost of \$40,000. If the throughput contribution margin (selling price minus direct material cost per unit) is greater than \$20 per unit ($\$40,000 \div 2,000$), this action would increase profits.
- 2) Process only products that increase throughput contribution margin and do not produce products that will simply remain in finished goods inventory. Making products that remain in inventory does nothing to increase throughput contribution margin.
- 3) Move products that do not need to be processed on the constraint operation to other, non-constrained machines or outsource them.
- 4) Reduce setup time and processing time at the constraint operation. If reducing setup time costs an additional \$10,000 per year but it enables the company to produce 500 additional units per year, again, if the throughput contribution margin is greater than \$20 per unit ($\$10,000 \div 500$), profits will increase.
- 5) Improve the quality of processing at the constrained resource. Poor quality is more costly at a constraint operation than at a non-constraint operation. A non-constraint operation has unused capacity, and no throughput contribution is forgone when it produces product that cannot be sold, so the cost of the defective production is limited to the wasted materials. However, unsellable product produced by the constraint operation costs more than just the cost of the materials that are wasted. The cost of poor quality at a constraint also includes the opportunity cost of lost throughput contribution margin, because the constraint does not have any extra time to waste. Lost time at the constraint is lost throughput contribution margin. So the constraint operation should not waste time processing units it receives from the previous process that are defective. Units in production should be inspected **before** they are passed on to the constraint operation for its processing.

If these actions are successful in increasing the capacity of the constraint operation, its capacity will eventually increase to the point where it exceeds the capacity of some other process; and so the other process will become the constraint. The company then focuses its continuous improvement actions on increasing the efficiency and capacity of the new constraint process, and so on.

Theory of Constraints Reports

A **Theory of Constraints Report** conveys **throughput contribution margin** and selected operating data. It identifies each product's throughput contribution margin per hour required for the constraint. It also identifies the most profitable product(s) and enables monitoring to achieve maximum profitability given existing constraints.

Calculating Throughput Contribution Margin

The concept of **throughput contribution margin** as it is used in Theory of Constraints analysis is a variation on the concept of **contribution margin**. The contribution margin is the difference between total revenues and total variable costs, and **contribution margin per unit** is simply the sale price for one unit minus the total variable costs for one unit. The variable costs included in the calculation of the contribution margin include direct materials, direct labor, variable overhead, and variable selling expenses.

However, in Theory of Constraints analysis, everything except for direct materials and any other totally variable costs is considered an operating cost, or a period cost. Thus, the throughput contribution margin, or throughput contribution margin per unit in TOC analysis, is the **selling price minus only the totally variable costs**, as referred to in the above discussion of TOC analysis. The totally variable costs are usually **only the direct materials costs**. This is called **super-variable costing**. As we said earlier, the assumption is made that labor and overheads are fixed costs because they can usually not be changed in the short term.

If you are asked on an exam to calculate **throughput contribution margin** (or throughput contribution or throughput margin – they all mean the same thing) for a period of time, you will need to calculate how many units can be produced in that time. The throughput contribution margin will be the throughput contribution margin per unit multiplied by the number of units that can be produced in the given time.

Example: Suppose we have an opportunity to get a special order for 100,000 units. We have excess capacity and we would really like to have this order. We are bidding against several other companies, so we know in order to get this order, we must get the price down as low as possible. We calculate our costs per unit as follows:

Direct materials	\$ 6
Direct labor	\$ 3
Fixed Overhead	<u>\$ 2</u>
Total	\$11

We determine that if we bid \$900,000 (\$9 per unit), we will just cover our variable costs. So we bid \$900,000. To our amazement, however, we lose the bid to a company that bid \$750,000.

If we had bid \$700,000, or \$7 per unit, we would have gotten the job. We would have recovered our materials costs and had an extra \$100,000 (\$1 per unit × 100,000 units). We would not have covered our direct labor cost; but then, we did not plan to lay off any people anyway. So in this situation, our direct labor cost is like a fixed cost because it will not change whether we have the order or whether we do not have the order.

If we had calculated a **throughput contribution margin** using a price of \$7 (\$7 – \$6 direct materials = throughput contribution margin of \$1) in preparing our bid instead, we would have gotten the job and would have made \$100,000 more in profit than we have without the job.

Next time, we will use the **throughput contribution margin** in preparing our bid.

Activity-Based Costing (ABC) is frequently used with TOC production planning. ABC allocates indirect and fixed costs to individual products or product lines based on the value-added activities that go into the given product. ABC is very helpful in performing value-chain analysis of the company's activities when making decisions about outsourcing, although traditional cost accounting is more appropriate when direct labor accounts for most of total costs for a company's products. ABC is more relevant in today's world where overhead may account for as high as 70–80% of manufacturing costs. This appropriate allocation of indirect costs and overhead is critical for decision-making, while traditional volume-based cost-driven systems understate the costs per unit of products with low sales volumes or high degrees of complexity. In essence, ABC enables accountants to accurately charge costs by allocating overhead more precisely than the traditional method.

ABC and TOC are complementary analytical tools that are used to assess the profitability of products. TOC takes a short-term approach to profitability analysis while ABC develops long-term analysis (price and profit planning). ABC includes all product costs, while TOC focuses only on materials costs. However, because ABC does not include the information on constraints and production capacity, TOC can be used to determine the best short-term product mix.

Question 152: Urban Blooms is a company that grows flowering plants and sells them in attractively designed container arrangements to upscale hotels, restaurants and offices throughout the greater New York City metropolitan area. When first established, the organization produced every aspect of its product on site and handled all business functions from its facility, in either the greenhouses, production areas or office. The only exception was importing expensive, large containers from Mexico. After five years in business, Urban Blooms had become very profitable and increased its staff from 10 to 200 employees, including horticulturalists, production/design workers, business managers and sales staff. However, the owners found it increasingly difficult to keep up with the complexities and demands brought about by the company's continuing growth. It became apparent that there were several areas that were not time- or cost-effective for Urban Blooms, such as putting together its own potting soil mix for the plants and maintaining payroll accounting. Urban Blooms contacted Hampshire Farms to create a special potting soil mix for their plants, and hired Lindeman Associates to handle the company's payroll accounting requirements.

This process is referred to as:

- a) Materials resource planning (MRP).
- b) Activity-based costing (ABC).
- c) Outsourcing.
- d) Lean production.

(HOCK)

Capacity Level and Management Decisions

Estimates about plant production capacity, called denominator level capacity, are used for various purposes. In Section A, we discussed production activity levels used in developing standards and the budget; and we discussed them again in Section C regarding allocation of overhead cost to production. We now need to talk about them in the context of management decisions, particularly decisions about pricing, bidding, and product mix.

A company does not need to use the same denominator level capacity for management decisions as it uses to set standards and allocate overhead. The capacity level used in making decisions should meet the need for the purpose for which it will be used. However, the definitions of the various choices of capacity levels are the same as we discussed in Sections A and C. Recall that those are:

- 1) **Theoretical, or Ideal** capacity – assumes the company will produce at its absolutely most efficient level at all times, with no breaks and no downtime.
- 2) **Practical** capacity – the most that a company can reasonably expect to produce in a year's time. This is the theoretical level reduced by allowances for idle time and downtime, but not for any possible decreases in sales demand.
- 3) **Master budget** capacity – the amount of output actually expected during the budget period based on expected demand.
- 4) **Normal** capacity – the level of annual activity that will be achieved in the long run that will satisfy average customer demand over a period of 2-3 years.

The level of plant capacity to use in decision-making is an important strategic decision that needs to be made by management. In fact, that decision should really be made before any decisions are made about how much plant capacity to provide. If the company needs to manufacture 15,000 units per year, then management needs to determine how much it will cost per year to acquire the capacity to make those 15,000 units.

In the short run, the capacity and its cost are fixed. If the company does not use all of the capacity it has available, the fixed costs of that capacity do not decrease the way variable costs do. If the cost to acquire and maintain the capacity to make 15,000 units per year is \$1,125,000 per year, then at a production level of 15,000 units, the fixed cost per unit is \$75. However, if the company does not produce 15,000 units in a given year but instead produces only 12,500 units, not all of the capacity supplied at \$75 per unit will be needed or used that year. The company will be paying for unused capacity. The fixed cost per unit produced based on actual production will be \$90 per unit ($\$1,125,000 \div 12,500$ units); but in reality, the fixed cost per unit should not change just because the number of units manufactured changes. The “real” fixed cost per unit manufactured is still \$75 per unit; and the company has **unused capacity cost** of \$187,500 for the units not produced ($\$75 \times [15,000 - 12,500]$) that it needs to absorb.

Pricing decisions and bidding decisions should be made using the \$75 per unit fixed cost that results from using **practical capacity** to calculate the fixed cost per unit, regardless of whether that volume is being produced or not.

Use of practical capacity as the denominator level for pricing and bidding decisions best expresses what the true cost per unit of supplying the capacity **should be**, regardless of the usage of the capacity. Recall that practical capacity is the absolute most that the company can reasonably expect to produce in a year’s time using the capacity it has. Therefore, practical capacity is the best denominator level to use in pricing and other management decisions.

Customers can not be expected to absorb the unused capacity cost by paying higher prices that the company charges per unit in order to cover the higher fixed cost it is allocating to each unit produced because production is below the expected level. Customers will not absorb it. They will take their business elsewhere. That will result in even lower production and even greater fixed cost per unit, even higher prices, and even lower sales. This is the dreaded **downward demand spiral**, and it can put a company out of business. Customers expect a company to manage its unused capacity or else to bear the cost of it itself, not to pass it along to them.

Since the use of practical capacity excludes the cost of the unused capacity from the per unit fixed cost, it gives management a more accurate idea of the resources that are needed in order to produce one unit of product and thus the resources needed to produce the volume the company is actually producing. If the company does not need all of its capacity, management should make adjustments. It may be that the company’s unneeded capacity can be rented or sold. Or, management might be able to make use of that unused capacity by developing a new product or by making arrangements to produce a product for another company that is outsourcing some of its manufacturing. Highlighting the cost of the unused capacity enables management to make strategic decisions for its use.

Capacity Level and Financial Statements

In Section C where we discussed the various activity levels that can be used in allocating overhead, we said the following:

“At the end of the accounting period, variances that result from differences between the actual overhead incurred and the overhead applied must be resolved as part of the closing activities. These variances may be prorated among ending work-in-process, ending finished goods, and cost of goods sold for the period. Or, they may be 100% closed out to cost of goods sold. A third approach (though not often used) is to restate all amounts using actual cost allocation rates rather than the budgeted cost application rates.

“If 100% of the variances are closed out to cost of goods sold, the use of master budget capacity or normal capacity will lead to the **highest net income** of these choices. This will be true whether actual overhead

incurred is greater than overhead applied (i.e., overhead is under-applied) or whether overhead incurred is less than overhead applied (i.e., overhead is over-applied).

"When master budget or normal capacity is used, the denominator level used will be the lowest of all the methods. (In some years, master budget capacity may be lower than normal capacity; and in other years, normal capacity may be lower than master budget capacity.) That means the resulting application rate will be the highest. Therefore, more manufacturing overhead will be allocated to the products throughout the period than it will be if theoretical or practical capacity is used. So, more manufacturing overhead will be included in the finished goods and work-in-process inventories on the balance sheet at the end of the period than would be the case with usage of the other denominator levels.

"When the variances are 100% closed out to cost of goods sold, no adjustment is made to inventories as part of the closing entries. So inventories under normal capacity will remain higher than under the other methods. Since inventories are higher, cost of goods sold will be lower. That is the reason why net income will be higher when normal capacity is used and 100% of the variances are written off to COGS.

"However, if variances caused by differences between the actual manufacturing overhead incurred and the overhead applied are prorated among inventories and cost of goods sold or if the amounts are restated using actual rates, the choice of the denominator level for allocating manufacturing costs during the period will have **no effect** on the end-of-period financial statements. Net income will be the same no matter which capacity level is used to set the overhead allocation rate for the period."

So, if the company chooses to close out its variances at the end of the period to cost of goods sold only, its choice of denominator level for standards and overhead allocation **will make a difference** in the net income it will report.

If variances are closed out to cost of goods sold only, then practical capacity is the preferred denominator level to use in setting standards and allocating overhead, for several reasons:

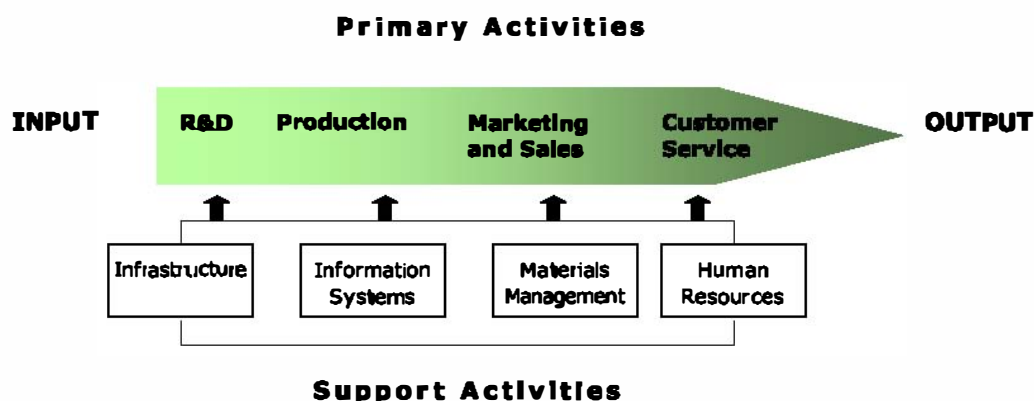
- 1) The use of practical capacity is required for income tax reporting under current Federal income tax regulations in the U.S. It is not essential that the same capacity level be used for tax purposes as for external financial reporting. However, if the same level is used for financial reporting as is used for income tax filing, then the choice of capacity level will not cause tax temporary differences leading to the need to perform deferred tax accounting in external financial reporting.
- 2) The use of practical capacity provides more uniform data over time. As a result, managers do not need to continually re-evaluate their decisions because of changing product-cost data.
- 3) The numerator in the fixed overhead predetermined per unit application rate calculation represents the **costs** of the capacity supplied, while the denominator represents the **amount** of capacity supplied. Therefore, use of practical capacity in the denominator is logically consistent with the numerator in the calculation.
- 4) The fixed overhead production-volume variance data will be apparent and can be interpreted as the **cost of the unused capacity**. This can assist management in making decisions about the proper amount of capacity to supply or to make use of unused capacity, as we discussed above.

If the company prefers to use the same denominator level capacity for pricing and other management decisions as it uses for standards and allocating overhead, then it should definitely use practical capacity for both. As we also discussed above, the use of practical capacity means that customers will not be burdened with the cost of unused capacity through higher prices being charged to them when actual or budgeted output is less than practical capacity. This will help the company to avoid the downward demand spiral that results from increasing its prices to cover increased per unit fixed costs because of decreased production.

Business Process Performance

The Value Chain

All of an organization's functions play a role in lowering the cost structure and increasing the perceived value of products and services through differentiation. This involves functions from R&D through production to marketing and sales, and on to customer service, including the activities that play supporting roles. The **value chain** describes the company's chain of activities for transforming inputs into the outputs that customers value. This process of transformation includes all of the **primary activities** (business functions) that add value to the product or service, as well as **support activities** as shown below.



Value chain analysis can help an organization gain competitive advantage by identifying what steps or activities do and do not increase the value to the customers. Once those areas are identified, the organization can increase the related benefits, or reduce (even eliminate) non value-added activities. The increase in value to the customer and/or the decrease in production costs will make the company more competitive. The firm should analyze each step in its operations carefully to determine how each activity contributes to the company's profits and its competitiveness.

Competitive advantage is an advantage that a company has over its competitors which it gains by offering consumers greater value than they can get from its competitors. The greater value may be in lower prices for the same product or service; or it may be in offering greater benefits and service than its competitors do, thereby justifying higher prices. A company that has competitive advantage will be more profitable than the companies it competes with for customers. The higher its profits are in comparison to its competitors, the greater its competitive advantage will be. Competitive advantage leads to increased profitability; and greater profitability leads to increased competitive advantage. Competitive advantage makes the difference between a company that succeeds and a company that fails.

In order to have competitive advantage, a company must have or create two basic things:

- **Distinctive competencies** and the **superior efficiency, quality, innovation** and **customer responsiveness** that result from them; and
- The **profitability** that is derived from the **value** customers place on its products, the **price** that it charges for its products, and the **costs** of creating those products.

Note: A company's **distinctive competencies** are the things that it does better than the competition.

Remember the four things that result from a company's distinctive competencies and that give the company competitive advantage:

- Superior efficiency,
- Superior quality,
- Superior innovation, and
- Superior customer responsiveness.

Primary Value Chain Activities

The primary value chain activities involve design, creation, marketing and delivery of the company's product or service and support and service after the sale. Primary activities are Research & Development, Production, Marketing and Sales, and Customer Service.

Research is the search for knowledge that can be used to create new or improved products, services or processes. **Development** uses those research findings in the planning process to improve these products, processes or services, which the company intends to sell or use internally. **Design** is the detailed planning and engineering for these efforts.

Production is the acquisition of raw materials, coordination and assembly required to produce a product or deliver a service. The costs of production include direct materials, direct labor and factory overhead (inventoriable costs).

Marketing and sales includes advertising, promotion and sales activities. **Distribution**, or delivery of products or services to customers, is also a part of marketing.

Customer service includes customer support and warranty services after a sale.

All of these activities contain opportunities to increase the value to the customer or to decrease costs without decreasing the value to the customer by reducing non-value adding activities.

The actual activities in a company's value chain will depend on the type of business the company is in. In a service industry, the focus will be on marketing, sales and customer service rather than on manufacturing and raw materials. The analysis should take place at a relatively detailed level of operations, at the level of processes that are just large enough to be managed as separate business activities.

Steps in Value Chain Analysis

There are **three steps in value chain analysis**:

- 1) **Identify the activities that add value to the finished product.** These activities depend upon the industry and what the company does (manufacturing, resale, etc.). They will be whatever activities this firm and firms in its industry perform in the processes of designing a product or service, manufacturing the product, marketing it and providing customer service after the sale.
- 2) **Identify the cost driver** or cost drivers for each activity, and
- 3) **Develop a competitive advantage by adding value to the customer or reducing the costs of the activity.** For example, **R&D** can add value to established products or services by finding ways to improve them, in addition to developing new ones. **Production's** function is to acquire the necessary raw materials and assemble them into finished goods. By doing this efficiently, costs can be lowered, leading to higher profits. **Marketing** adds value by informing customers about the products or services, which may increase the utility that customers attribute to the product or service and enable the company to charge a higher price. Marketing can also discover what customers want and need through marketing research and communicate that to the R&D group so the R&D group can design products that match the customers' needs. **Customer service** after the sale adds value by delighting customers with the responsive service received, thus creating superior value for them. Increased utility for customers because of excellent customer service can also enable the company to charge more for its products.

Value chain analysis can also be used to determine what place a firm should occupy in a complete value chain that consists of multiple businesses. The main concept in this type of value chain analysis is that each firm occupies a selected part or parts of the entire value chain. Which part or parts of the value chain to occupy is determined by comparative advantage of the individual firm, or where the firm can best provide value at the lowest possible cost. Some firms manufacture parts that they sell to other firms, who take those parts and put them together to manufacture another product entirely. Then those products may be sold to a wholesaler, who sells them to a retailer, who sells them to the ultimate consumer. Each of these manufacturers, sellers and resellers occupies a place in the **value chain**.

Question 153: The primary activities or business functions that are considered in the value chain include:

- a) Customer service, production, marketing and sales, and human resources.
- b) Customer service, production, marketing and sales, and information systems.
- c) Infrastructure, human resources, materials management, and R&D.
- d) Customer service, production, marketing and sales, and R&D.

(HOCK)

Business Process Reengineering

Reengineering originally referred to the process of disassembling a product in order to redesign it, but it more recently applies to restructuring that is brought about by rapidly changing technology and today's competitive economy. For instance, instead of simply using computers to automate an outdated process, technological advances bring opportunities to fundamentally change the process itself. In applying the concept of process reengineering, management starts with a clean sheet of paper and redesigns processes to accomplish its objectives. Operations that have become obsolete are discarded.

Unless a company monitors and controls its basic business operations, it cannot make the gradual changes over time that will permit it to adjust to changing conditions. It may find that changes in the business environment and shifts in technology have made not only its processes but also its products obsolete, endangering its continued existence. Business process reengineering can help a company operate more effectively.

The steps in business process reengineering are:

- 1) The organization must identify **what it does better than the competition**. These are its **distinctive competencies** and by clearly identifying them, the organization can understand what activities are vital to its success.
- 2) Management needs to determine what **processes** it uses to convert materials, capital, information and labor into products or services that have value. The organization is viewed as a **series of processes**, enabling management to determine the degree of value for each process, which can uncover legacy processes that should be discarded.

A **business process** is any activity required for delivering goods and services to customers quickly. It is also any activity that results in higher quality or lowered costs. A business process is an activity that is not the responsibility of any one function but rather it encompasses several functions.

Managers who use reengineering need to completely rethink how their value-chain activities are organized. The organization should **focus on processes, not on functions**. Reorganization should take place around **horizontal processes**, which requires cutting out unnecessary middle management levels, thus flattening the organization. Management is an indirect cost, and the necessary amount of management should be minimized.

Since business process reengineering focuses on processes and not on functions, reengineering involves adopting a brand new approach to the organization of activities. The current organization chart is deliberately ignored. The reengineering process begins *with the customer*, not with the company's product or service. The management asks itself how it can reorganize the way work is done to provide the best quality and the lowest-cost goods and services *to the customer*.

Frequently, the answer to the question is that there are more effective ways to organize the company's value-chain activities. A business process might be being performed by several different people in different areas who pass the work from person to person. Instead, the same process might be able to be performed by one person or one group of people all working together, at lower cost. Individual job assignments might become more complex and thus more challenging, and the grouping of people into cross-functional teams can both reduce costs and increase quality.

After the business process reengineering has been completed and the value-chain activities have been reorganized to get the product to the final customer more efficiently, quality management takes over and focuses on continued improvement and refinement of the new process.

Benchmarking Process Performance

One of the best ways to develop the **distinctive competencies** that lead to **superior efficiency, superior quality, superior innovation** and **superior responsiveness to customers** which confer **competitive advantage** on a firm is to identify and adopt **best practices**. This can be accomplished through **benchmarking**.

A benchmark is a standard of performance; and **benchmarking** is the process of measuring the organization against the products, practices and services of some of its most efficient global competitors. The company can use these standards as a target or model for its own operations. This is also called **best practices**. Through the application of research and sophisticated software analysis tools, companies undertake **best practice analysis** to cut costs, boost output, and achieve their strategic business goals and objectives.

This process continuously strives to emulate (imitate) the performance of the best companies in the world, and through meeting these higher standards, the organization may be able to create a **competitive advantage** over its marketplace competitors. The benchmarked company does not need to be in the same industry as the company that is trying to improve its performance.

The first thing that a company must do is identify the **critical success factors** for its business and the processes it needs to benchmark. **Critical success factors** are the aspects of the company's performance that are essential to its competitive advantage and therefore to its success. Each company's critical success factors depend upon the type of competition it faces.

After this, a team is set up to do **best practice analysis**. Best practice analysis involves investigating and documenting what the **best practices** are for the processes that are used in performing the firm's critical success factor activities. The team members should be from different areas of the business and have different skills. The team will need to identify what areas need improvement and how they will accomplish this by utilizing the experience of the benchmarked company.

Certain companies are generally recognized as leaders in specific areas. Some examples are Nordstrom for retailing, Ritz-Carlton Hotels for service, Toyota for manufacturing, and Apple Computer for innovation. The American Productivity and Quality Center (www.apqc.org), a non-profit organization, is a resource for companies that want to do benchmarking. APQC is one of the world's leading proponents of business process and performance improvement. It maintains a large benchmarking database and offers firms several ways to participate in benchmarking and to access benchmarking information.

Activity-Based Management (ABM)

Activity-based management (ABM) is closely related to and draws upon data from activity-based costing. As we saw in the previous section on costing, activity-based costing uses activity analysis to develop detailed information about the specific activities the company uses to perform its operations. Activity-based costing improves tracing of costs to products and can even be used to trace costs to individual customers.

However, activity-based costing data is not just useful for costing. Activity-based management, drawing on activity-based costing data, is a means of performing value chain analysis and business process reengineering. Activity-based management uses activity analysis and activity-based costing data **to improve the value of the company's products and services and to increase the company's competitiveness.**

Activity-based management is divided into **operational ABM** and **strategic ABM**.

Operational ABM uses ABC data to **improve efficiency**. The goal is for activities that add value to the product to be identified and improved, while activities that do not add value are reduced in order to cut costs without reducing the value of the product or service.

Strategic ABM uses ABC data to **make strategic decisions** about what products or services to offer and what activities to use to provide those products and services. Because ABC costs can also be traced to individual customers, strategic ABM can also be used to do customer profitability analysis in order to identify which customers are the most profitable so the company can focus more on them and on serving their needs.

The Concept of Kaizen

The term **kaizen** is a Japanese word that means "improvement." As used in business, it implies "continuous improvement," or slow but constant incremental improvements being made in all areas of business operations. Small-scale improvements are considered to be less risky than a major overhaul of a system or process. The slow accumulation of small developments in quality and efficiency can, over time, lead to very high quality and very low costs. *Kaizen* needs to be a part of the corporate culture. It requires conscious effort to think about ways that tasks could be done better. This can be difficult to maintain and takes years to show results, but if done properly, it confers a sustained competitive advantage.

Kaizen principles can also be used for a "blitz," in which substantial resources are committed to a focused, short-term project to improve a process. A blitz usually involves analysis, design, and reengineering of a product line or area. The results can be immediate and dramatic.

Kaizen can be used along with activity-based management and activity-based costing in a business process reengineering project to improve the quality and/or reduce the cost of a business process.

Kaizen also has something to say about standards in manufacturing. If you recall, we said that standard costs may be either **ideal standards**, attainable only under the best possible conditions, or **practical, expected costs**, which are challenging to attain, but attainable under normal conditions. Toyota, the company most recognized for its use of *kaizen*, would say that standards are temporary and not absolutes. Improvement is always possible, and the goal is to attain the **ideal standard**. Even though practical standards are being attained, the ultimate goal is still not being achieved.

A company may use **target costing** along with *kaizen* principles to determine what its ideal standard costs are. This puts the focus on the market because it starts with a **target price** based on the market price. The market determines the target price, and the company must attain the target cost in order to realize its desired profit margin for the product. The ideal standard is thus defined as the target cost, or the standard cost that will enable the company to attain its desired cost and desired profit margin. Using *kaizen* principles, the company figures out how it can manufacture the product for the target cost. The standard is achieved through development of new manufacturing methods and techniques that entail continuous improvement or the ongoing search for new ways to reduce costs.

Implementing ideal standards and quality improvements is the heart of the *kaizen* concept. *Kaizen* challenges people to imagine the ideal condition and strive to make the necessary improvements to achieve that ideal.

Organizations can also apply *kaizen* principles to the budgeting process. Because *kaizen* anticipates continuous improvements in the production process, a budget developed on *kaizen* principles will incorporate planned improvements, resulting in decreasing costs of production over the budget period.

Note: **Kaizen** is the Japanese term for **improvement** and it is used in business to mean **continuous improvement**.

The Costs of Quality

Management will also be closely interested in the **cost of quality**. The cost of quality includes not only the cost of producing quality products, but it is also the cost of **not** producing quality products. Over the long term, **not** producing a quality product is more expensive because it means that the company will lose customers.

There are **four different costs of quality and they are classified into two larger categories**, which are the cost of conformance and the costs of nonconformance. There are two subcategories of costs within each of these two larger categories.

The costs of conformance are the costs to produce a quality product, and they can be broken down into **prevention costs** and **appraisal costs**. The costs of non-conformance are the costs of **not** producing a quality product, and they can be broken down into **internal failure costs** and **external failure costs**.

Cost of Conformance

The costs of conformance are the costs that the company incurs to assess internal quality with the purpose of insuring that no defective products reach the consumer.

The two types of costs of conformance are:

- 1) **Prevention costs** are the costs that are incurred in order to prevent a defect from occurring in the first place. Prevention costs include:
 - Quality training and planning costs,
 - Equipment maintenance costs,
 - Supplier training and confirmation costs, and
 - Information systems costs.
- 2) **Appraisal costs** are the costs that are incurred in order to determine if an individual unit is defective. These are the costs of:
 - Testing and inspection (including the costs of the testing equipment),
 - Quality audits, and
 - Internal quality programs.

Costs of Nonconformance

Nonconformance costs are those costs that are incurred after a defective product has already been produced. The costs of nonconformance can be broken down into two types:

- 3) **Internal failure** occurs when we detect the problem before shipment to the customer. The **costs** associated with this are:
 - Rework,
 - Scrap,
 - Tooling and downtime, and

- Expediting costs - The cost of rushing to reperform and complete an order in time because of a failure to complete it correctly the first time.
- 4) **External failure** occurs when we do not detect the defect until the product is already with the consumer. The costs of this are:
- Warranty costs,
 - Product liability costs,
 - The loss of customer goodwill (including customer complaints), and
 - Environmental costs.

Note: You need to make certain that you know what the four subcategories of the costs of quality are and what individual items go into these four types of costs.

Opportunity Costs of Quality

The nonconformance costs include **opportunity costs associated with poor quality**. An opportunity cost is the benefit of the next best use of the resource that was lost.

There are several ways in which a company can generate opportunity costs because of defective products it produces.

- It must either repair or replace defective products that fail within the warranty period and/or products that may be recalled if the defect is serious. If the product is repaired, the company must spend time and pay people to fix or replace the defective parts. The people the company pays to do this could have been producing more parts for sale instead of spending their time on something that will not produce any revenue, and the replacement parts used could have been used in new products instead. If the whole product is replaced, the products used to replace the defective ones are products that could have been sold, but instead they will not generate any revenue even though their production creates costs.
- It will need to provide more customer service after the sale, so it will need to pay more customer service employees. The extra people spending their time on customer service for the defective products could have been doing something else for the company that would be more productive.
- It will lose future sales because it will gain a reputation of supplying poor quality products. The lost future sales represent lost profits. Here, the lost resource is the cash profits that could have been earned from the lost sales. If the company had that cash, it could invest it and earn more future profits with it.
- There is another opportunity cost associated with poor quality management, and it concerns **design quality** failures. Costs of design quality are costs that either prevent poor quality of design or that arise as a result of poor quality of design. Design quality failure costs include the costs to design, produce, market and distribute a poorly designed product as well as costs to provide service after the sale for it. In addition, design quality failures can cause lost sales because the product is not what customers really want. Design quality failures can be a significant component of design quality costs.

Note: It is interesting to note that in manufacturing, it is often said that the main causes for quality problems are the "4 Ms": **machines, materials, methods and manpower**.

Total Quality Management (TQM)

TQM describes an approach that is committed to customer satisfaction and continuous improvement of products or services. The basic premise of TQM is that quality improvement is a way of increasing revenues and decreasing costs. As such, a company should always strive for improvement in performing its job and producing its product **correctly the first time**.

At the heart of TQM is the definition of what quality is. Quality can mean different things to different people. For a customer it is a product that meets expectations and performs as it is supposed to for a reasonable price. For a production manager it is a product that is within the required specification. When a company is considering quality, it must be certain to include all of these different perspectives of quality from all of the involved parties.

Total quality management programs are often developed to implement an overall low-cost or a differentiation business strategy, because TQM's goals are to both reduce costs and improve quality. Approximately 90% of manufacturing companies and 70% of service businesses have put into practice some form of a TQM program, but success or failure revolves around involvement and leadership of senior management. A TQM program requires a change in corporate culture by eliminating faulty processes, empowering employees and creating teamwork that focuses on quality.

The objectives of TQM include:

- Enhanced and consistent quality of the product or service,
- Timely and consistent responses to customer needs,
- Elimination of non-value adding work or processes, which leads to lower costs, and
- Quick adaptation and flexibility in response to the shifting requirements of customers.

Certain core principles, or **critical factors**, are common to all TQM systems:

- They have the support and active involvement of top management.
- They have clear and measurable objectives.
- They recognize quality achievements in a timely manner.
- They continuously provide training in TQM.
- They strive for continuous improvement (*kaizen*).
- They focus on satisfying their customers' expectations and requirements.
- They involve all employees.

TQM is an **organizational action**. For it to be successful, the entire organization must strive to this end. This leads to the continued pursuit of excellence throughout the organization.

Part of this pursuit of excellence is a focus on continuing education. Employees at all levels participate regularly in **continuing education and training** in order to promote and maintain a culture of quality.

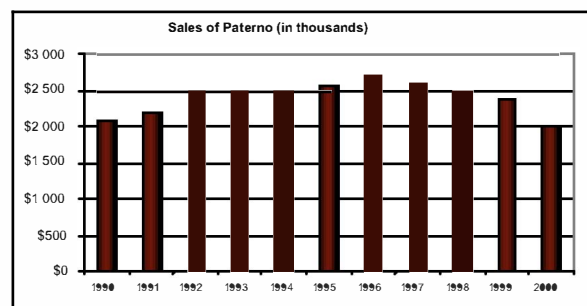
One of the unique perspectives of TQM relates to customers. In a TQM system, it is important to remember that **people within the organization are also customers**. Every department, process or person is at some point a customer and at some point a supplier.

Another feature of TQM is **quality circles**. A quality circle is a small group of employees who work together and meet regularly to discuss and resolve work-related problems and monitor solutions to the problems. This form of communication is vital to a successful TQM program.

In TQM, the role of quality manager is not limited to a special department; instead, **every person in the organization** is responsible for finding errors and correcting any problems as soon as possible.

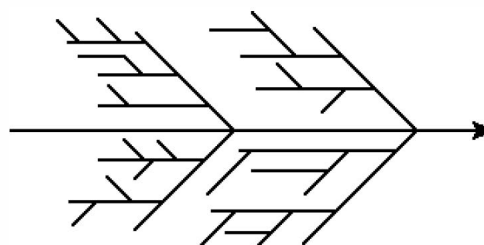
To achieve **total quality management**, the company must identify the relevant quality problems when and/or where they occur, and then use some of the following, or similar, methods to analyze them:

- A **control chart** records observations of an operation taken at regular intervals. This sample is used to determine whether all the observations fall within the specified range for the operation, and the intervals are measurable in time, batches, production runs or any other method of delineating an operation. If no sample falls outside the limits, it is **in statistical control** when all samples are randomly distributed with no apparent patterns, and if the numbers of observations that are above and below the center of the specified range are about equal. If there are trends, clusters, or many measurements near the limits, the process may be out of control.
- A **histogram** is a bar graph that represents the frequency of events in a set of data. Patterns that may not be apparent when just looking at a set of numbers become clear in a histogram, which can pinpoint most of the problem areas. For instance, if a particular production line is experiencing most of the difficulty, a histogram can help determine what types of problems are causing the problems most often. Here is an example of a histogram:



- A **Pareto** diagram is a specific type of histogram. Vilfredo Pareto, a 19th-century Italian economist, came up with the now well-known 80-20 observation, or **Pareto principle**. We know it as "20% of the population causes 80% of the problems"; or "20% of the population is doing 80% of all the good things." After management pinpoints which 20% of the causes are accounting for 80% of the problems, it can focus efforts on improving the areas that are likely to have the greatest overall impact.
- A **cause-and-effect diagram, or Ishikawa, diagram**, organizes causes and effects visually to sort out root causes and identify relationships between causes. This idea was identified by Karou Ishikawa, who noted that it is often difficult to trace the many causes leading to a single problem, and as a result, developed a way of diagramming them. An Ishikawa diagram consists of a spine, ribs and bones; so it is also called a fishbone diagram. The end of the spine is the quality problem; the spine itself connects the main causes, the ribs — to the effect, the quality problem.

Ishikawa Diagram



Total Quality Management and Activity-Based Management

As already discussed, activity-based management principles are widely used to recommend **process performance improvements**. It is applied to help companies make better strategic decisions, enhance operating performance, reduce costs, and benchmark performance. Activity-based management uses **activity-based costing** data to trace costs to products and/or individual customers for the purpose of analyzing business process performance.

A **total quality management** system is most compatible with an ABC system because the ABC system makes the costs of quality more apparent. A firm with a good ABC system only needs to modify it to identify costs and activities relating to costs of quality. A company that utilizes ABC will also be continuously identifying activities that can be eliminated, as well as ensuring that necessary activities are carried out efficiently.

Unnecessary and inefficient activities are **non-value added activities**, and the cost drivers of those activities need to be reduced or eliminated. Activity to rework defective products is a non-value added activity and thus needs to be reduced or eliminated. On the other hand, the company needs to carry out the **value-added activities** as efficiently as possible. A focus on TQM and its central tenet of **continuous improvement** will lead to achieving both of these goals.

ISO 9000

The International Organization of Standardization introduced the ISO 9000 quality assurance standards. These standards do not have the force of law, but have been adopted by the EU. This means that if a company fails to obtain these standards, it runs the risk of losing business due to perceived lack of quality. The standards are **not set to assure the quality of an individual product, but to assure that the quality is the same throughout all of the company's product of that type**.

Note: Adherence to (following) design specifications is one of the most important components of quality control.

Quality Management and Productivity

At first glance, it may seem that as a company's commitment to quality increases, the productivity of the company will decrease. Since productivity is measured as the level of output given an amount of input, it would seem that by allocating resources to quality and spending resources in the quality process, there would be fewer outputs for the level of inputs.

This, however, is not the case. In fact, as a company's commitment to quality increases, productivity also increases. There are a number of reasons for this, including:

- **A reduction in the number of defective units.** This in turn reduces the amount of time, material and effort wasted on unusable output as well as time spent fixing salvageable defective units. (There is a term called the **hidden factory** that refers to the time and effort spent on rework and repair.)
- **A more efficient manufacturing process.** By looking from a quality production standpoint, the company may remove or change inefficient, unproductive or non-value adding activities.
- **A commitment to doing it right the first time.** This is related to the first item, but as the culture in the company focuses on doing it right the first time, the employees of the company can take a more conscientious approach to their work, and this may lead to greater productivity.

No matter the cause, the relationship between quality and productivity is a positive one – the more attention paid to quality, the higher the levels of production.

Other Quality Related Issues

With the development of a good TQM system, a company can also manage its time better and become more productive. In today's environment, it is ever more important to become the first company to get a new product or service to the marketplace. This is seen in the need to have **shorter product development time** and **shorter response times** to changes in demand or the market.

Customer-response time, or **cycle time**, is the measurement of the length of time between the order by the customer and the receipt of the product by the customer. The components of cycle time are **order receipt time** (from receipt of order until we are ready to produce it), **manufacturing cycle time** (from readiness to produce to completion of the product), and **order delivery time**.

Question 154: The most important component of quality control is:

- a) Conforming to ISO-9000 specifications.
- b) Determining the appropriate timing of inspections.
- c) Ensuring goods and services conform to the design specifications.
- d) Satisfying upper management.

(CIA Adapted)

Question 155: An example of an internal, nonfinancial benchmark is:

- a) The labor rate of comparably skilled employees at a major competitor's plant.
- b) The average actual cost per pound of a specific product at the company's most efficient plant becoming the benchmark for the company's other plants.
- c) The company setting a benchmark of \$50,000 for employee training programs at each of the company's plants.
- d) The percentage of customer orders delivered on time at the company's most efficient plant as a benchmark for the company's other plants.

(CIA Adapted)

Question 156: Of these statements, which is not relevant to the overall benchmarking process?

- a) Management must determine what processes the company uses to convert materials, capital and labor into value-adding products.
- b) Management must use target costing to set standard costs in order to put the focus on the market as well as on what target price to sell the product because the company must attain the target cost to realize its desired profit margin for the product.
- c) Target costing utilizes kaizen to reduce costs in order to attain a desired profit margin.
- d) Management must put in place a program to measure the organization against the products, practices and services of the most efficient competitors in its marketplace.

(HOCK)

Question 157: The management and employees of a large household goods moving company decided to adopt total quality management (TQM) and continuous improvement (CI). They believed that if their company became nationally known as adhering to TQM and CI, it would result in increased profits and market share. The primary reason for adopting TQM was to achieve:

- a) Greater customer satisfaction.
- b) Reduced delivery charges.
- c) Greater employee participation.
- d) Reduced delivery time.

(CIA Adapted)

Question 158: Which of the following is not an objective of a company's TQM program?

- a) To examine issues relating to creating value for the company's customers.
- b) To understand the company's capacity for innovation.
- c) To evaluate environmental issues that may affect the company's profitability.
- d) To utilize computers in product development, analysis and design modifications.

(HOCK)

Question 159: Which of the following is a characteristic of TQM?

- a) Education and self-improvement.
- b) Management by objectives.
- c) Quality by final inspection.
- d) On-the-job training by other workers.

(CIA Adapted)

Question 160: Which of the following statements is/are true?

- a) As it applies to an individual company, the Pareto principle should indicate that management needs to know what 50% of the causes are accounting for 80% of the problems before it can focus on making improvements.
- b) Companies use best practice analysis to cut costs but it is not effective for increasing output.
- c) One of the steps in business process reengineering is the identification of its distinctive competencies.
- d) A TQM system is not compatible with an ABC system because it does not make the costs of quality more apparent.

(HOCK)

Question 161: The cost of scrap, rework and tooling changes in a product quality cost system are categorized as a(n):

- a) External failure cost.
- b) Training cost.
- c) Prevention cost.
- d) Internal failure cost.

(CMA Adapted)

Question 162: Listed below are selected line items from the Cost of Quality Report for Watson Products for last month.

<u>Category</u>	<u>Amount</u>
Rework	\$ 725
Equipment maintenance	1,154
Product testing	786
Product repair	695

What is Watson's total prevention and appraisal cost for last month?

- a) \$2,665
- b) \$1,154
- c) \$786
- d) \$1,940

(CMA Adapted)

Section D – Internal Controls

Section D comprises 15% of the CMA Part 1 Exam. This section is composed of three parts – Risk Assessment, Controls and Risk Management; Internal Auditing; and Systems Controls and Security Measures.

Internal control examines all of the controls that the company has set up and put in place to help achieve its objectives. We often think of internal controls as trying to prevent something from going wrong, but they are really set up to assist the organization in the achievement of its objectives. It is important to be very familiar with the objectives of internal control.

Other important topics are the major internal control provisions of the Sarbanes-Oxley Act of 2002 in Sections 302 and 404 of the Act and the role of the PCAOB (Public Company Accounting Oversight Board), which was established by the Sarbanes-Oxley Act.

Two of the main elements of internal control that you need to understand are the **segregation of duties** and the **elements that make up the components of internal control**. It is important to know these topics, and the other internal control topics, not only from an academic standpoint (definitions and lists, for example) but also from a practical application standpoint. The answers to the application related questions can be very difficult because it may seem that all of the choices are good controls or none of the duties are ones that can be performed by the same person. However, when you face these questions, don't spend too much time thinking about any particular one because each has the same value, and therefore there is no benefit to figuring out a hard question versus answering a simple one.

There are also a lot of questions from past exams that have covered specific situations relating to internal control, internal audit, and systems control. These items are not covered in specifics in this textbook because of the vast scope of potential topics that would need to be covered. Rather, these types of questions are included in ExamSuccess. You do not need to remember every specific detail from a question, but you will want to be familiar with the concepts and issues covered in those questions. The best we can advise you to do is to learn the overall concepts and issues and then apply your best professional judgment to answering questions about them. You will find the actual exam questions to be different from the practice questions in your study materials, since the practice questions are previous exam questions. The actual exam questions are always being updated and changed, so it is not likely that past exam questions will be asked again. For that reason, we have determined not to try to "teach to the study questions" in this section of the study materials. In this textbook, we prefer to focus on the topics covered in the ICMA's current Learning Outcome Statements, as we believe questions asked on an exam today are more likely to be from the current Learning Outcome Statements than they are likely to duplicate past exam questions.

Most of the concepts covered in the Risk Assessment, Controls and Risk Management portion of this section are adapted from the report *Internal Control – Integrated Framework* developed by COSO, the Committee of Sponsoring Organizations of the Treadway Commission. The sponsoring organizations included the American Institute of Certified Public Accountants, the American Accounting Association, the Institute of Internal Auditors, the Institute of Management Accountants, and Financial Executives Institute. The report was published in 1992 and is the guide for all internal control systems.

The second part of this section is Internal Auditing. This focuses on the audit function that the company operates internally, apart from the external audit of the financial statements. The internal audit function has duties that spread far beyond the financial statements and some of these responsibilities may not relate to money directly. For example, the internal audit function may be involved in time or quality audits.

When studying for internal audit, you need to prepare for this topic on two levels. First, as usual, is the definitional and conceptual level. You need to know the characteristics of a successful internal audit function, how internal auditors test compliance with controls and evaluate the effectiveness of controls, and understand the reporting relationships and how they are set up. On the second level you must be able to answer questions about the work that internal auditors do, and in some cases, what types of procedures should be performed or how and to whom certain things should be reported.

Other important information includes the internal control and auditing provisions of relevant legislation, especially the Sarbanes-Oxley Act and the related guidance in PCAOB Auditing Standard 5 and SEC Release 33-8810.

The third part within this section is Systems Controls and Security Measures. In this part you will need to become familiar with the terminology that is involved. Some of this you may be familiar with from work or experience with computer systems, but it is important that you know the terminology.

Risk Assessment, Controls and Risk Management

The internal controls of a company are an important part of its overall operations. A strong internal control system will provide many benefits to a company including:

- Lower external audit costs,
- Better control over the assets of the company, and
- Reliable information for use in decision-making.

A company with weak internal controls is putting itself at risk for employee theft, loss of control over the information relating to operations, and other inefficiencies in operations and decision-making that can damage its business.

Internal Control Definition and Objectives

According to the COSO publication, *Internal Control – Integrated Framework*^v, internal control is a method, or process, that is carried out by an entity's board of directors, management and other personnel that is designed to provide **reasonable assurance** that the company's objectives in the following three categories will be achieved:

- 1) **Effectiveness and efficiency of operations**, or the extent to which the company's basic business objectives are being achieved and its resources are being used effectively and efficiently. These include performance goals, profitability goals and safeguarding of resources.
- 2) **Reliability of financial reporting**, including preparation of all published financial information. In addition to the full set of financial statements, this includes interim and condensed financial statements and any selected financial data from those statements, such as earnings releases, that are reported publicly.
- 3) **Compliance with applicable laws and regulations**, encompassing all laws and regulations to which the company is subject.

These three categories of objectives are distinct, but they do overlap. A specific control objective of a specific company could fall under more than one category. However, the three categories address different needs and they may be the direct responsibility of different managers.

Objectives numbered 2) and 3), the **financial reporting** and **compliance** objectives, are based largely on standards that are imposed by external entities, such as the SEC, financial reporting standards, and laws of the land. A company's achievement of these objectives is within the company's control, because it depends upon how activities that are within the company's control are performed. Internal control can provide **reasonable assurance** of the company's achieving these objectives.

^v *Internal Control – Integrated Framework*, copyright 1992, 1994 by the Committee of Sponsoring Organizations of the Treadway Commission. Used by permission. The Committee of Sponsoring Organizations of the Treadway Commission includes the following five organizations: American Institute of Certified Public Accountants (AICPA), American Accounting Association (AAA), Institute of Internal Auditors (IIA), Institute of Management Accountants (IMA), and Financial Executives International (FEI).

However, objective number 1), achievement of **operations objectives**, may not be within the company's control. Achievement of operations objectives is dependent upon management judgment and decisions and many times on external events that are beyond management's control. Good internal control cannot prevent bad judgments and decisions, and it cannot control external events. For this reason, an internal control system **cannot provide reasonable assurance that operations objectives will be met**. An internal control **system** can only provide **reasonable assurance that management and the board of directors are being made aware** of whether or not the company is progressing toward its operational objectives, and being made aware **in a timely manner**.

Therefore, internal control can be judged effective if members of management have reasonable assurance that:

- 1) They **understand the extent** to which the company's operations objectives are being achieved;
- 2) Published financial statements are being prepared reliably; and
- 3) Applicable laws and regulations are being complied with.

As a process, internal control is a **means to an end, not an end in itself**. Internal control can **provide reasonable assurance but not a guarantee** that these objectives will be met. People, not policy manuals or forms, carry out internal control. Internal control is a process; and its effectiveness is the condition of the process or the state of the process at any given point in time.

Development of Internal Control Concepts

Ever since commercial organizations, nonprofit organizations and governments have existed, their leaders have recognized the need to exercise control in order to ensure that their objectives were achieved. Today, however, the leaders of an organization are not the only ones who care about its internal control policies and procedures.

- For a public company, information on the effectiveness of its internal control system is important to **investors** to enable them to evaluate management's performance of its stewardship responsibilities as well as the reliability of its financial statements.
- The company's **external auditors** recognize that an audit of a company with effective internal controls can be performed more efficiently.
- The potential for U.S. corporations to make illegal political contributions or illegal payments to foreign governments is of concern to **legislative and regulatory bodies** and is addressed through internal control policies and procedures.
- The development of larger organizations with increased numbers of employees has made it necessary for **management** to limit and direct employees' authority and discretion.
- Even **customers** have an indirect interest in internal controls because a strong internal control system may reduce the costs of production, and therefore also reduce products' prices.

Who Is Responsible for Internal Control?

Before we get into the details of internal controls, we should start by discussing who is responsible for internal controls.

Many people believe that the internal audit function has primary responsibility for establishing and maintaining the internal control system. But the COSO report, *Internal Control – Integrated Framework* (1992) corrected that belief. The COSO report advanced the practice of corporate governance by delineating the responsibility of each group or person listed below to maintain and assess internal controls as follows:

- The **board of directors** is responsible for **overseeing** the internal control system, providing governance, guidance and insight.
- The **CEO** is ultimately responsible for the internal control system and the “**tone at the top**”. The CEO should provide leadership and direction to the senior managers and review the way they are controlling the business. This tone (called the **control environment**) is discussed in more detail below.
- **Senior managers delegate responsibility** for establishment of specific internal control policies and procedures to personnel responsible for each unit’s functions.
- **Financial officers and their staffs** are central to the exercise of control, as their activities cut across as well as up and down the organization. However, all management personnel are involved, especially in controlling their own units’ activities.
- **Internal auditors** play a monitoring role. They evaluate the effectiveness of the internal controls established by management, thereby contributing to their ongoing effectiveness.
- Virtually **all employees** are involved in internal control, because all employees produce information used in the internal control system or carry out other activities that put the internal control systems into effect. Furthermore, all employees are responsible for letting their managers know if they become aware of problems in operations or that rules, regulations or policies are being violated.

External parties provide information that is useful to effective internal control. For example, **independent auditors** audit the financial statements and often provide other useful information as well to management and the board. Other external parties that may provide useful information include legislators, regulators, customers, financial analysts, bond raters and the news media. However, external parties are not part of the company’s internal control system, and they are not responsible for it.

Note: Internal auditors evaluate the effectiveness of the control systems and contribute to their ongoing effectiveness, but they do NOT have the primary responsibility for establishing or maintaining the control systems.

The COSO report changed the concept of internal controls from narrow, technical terms of financial reporting to include all aspects of business operations and compliance, and it established a standard against which all organizations could measure their internal control systems.

Note: Internal control should be an explicit or implicit part of everyone’s job description.

Components of Internal Control

According to the COSO report, *Internal Control – Integrated Framework*, five interrelated components comprise internal control. They are:

- 1) **C**ontrol **E**nvironment
- 2) **R**isk Assessment
- 3) **C**ontrol Activities
- 4) **I**nformation and Communication
- 5) **M**onitoring

Note: These elements may be remembered by the mnemonic CRIME as identified by the bold letters in the list above, though CRIME does not put the components in the correct order. It is important to know that the Control Environment is the basis for all the other components and thus should come first, not last (as it would using the mnemonic CRIME). You should know not only what these components are, but what each term means and includes.

Component 1: The Control Environment

The **control environment** provides the foundation for all the other components. It influences the control consciousness of all the people in the organization and sets the tone for the entire organization. Control environment factors that influence the scope and effectiveness of the control environment include:

- The **integrity and ethical values** of the entity's people. The effectiveness of internal controls is directly dependent upon the integrity and ethical values of the people who create, administer and monitor them. Therefore, integrity and ethical values affect the design, administration and monitoring of the other internal control components. Every company should have a code of conduct and formal policies regarding acceptable business practice, conflicts of interest, and expected standards of behavior.
- A **commitment to competence**. In order for tasks to be accomplished in accordance with the company's objectives and plans for achievement of those objectives, the company needs to have competent personnel. In order to have competent personnel, management should specify the knowledge and skills required for each position. There should be formal or informal job descriptions.
- The attention and direction provided by the **board of directors and/or audit committee** have significant influence over the "tone at the top" and thus over the control environment. Important factors are their independence from management, the experience and stature of their members, the extent of their involvement and their oversight over activities, the appropriateness of their actions and their willingness to ask the difficult questions. Board and audit committee members should hold regular meetings with chief financial and accounting officers and internal and external auditors. Sufficient and timely information should be provided to board and audit committee members. The responsibilities of the board of directors and of the audit committee are discussed in detail later.
- **Management's philosophy and operating style**. This affects the way the company is managed. Companies may be managed informally through face to face contact or formally through written policies, performance indicators and exception reports. Management philosophy and operating style also include things like conservative or aggressive accounting principles and accounting estimates, and attitudes toward functions and personnel. The nature of the business risks taken by management is important, such as whether management enters into high-risk ventures or is conservative in accepting risks.
- The company's **organizational structure** provides the framework for planning, executing, controlling and monitoring the activities it pursues to achieve its objectives. These activities may be part of the primary activities or the support activities in the company's value chain as discussed in Section C

of this book in the section on Business Process Performance. Key areas of authority and responsibility and appropriate lines of reporting need to be established. The type of organizational structure a company needs depends on its size and its activities. A large organization needs a highly structured organization with formal reporting lines and responsibilities; while that amount of formality might not be needed and in fact could impede the flow of information in a smaller organization. The structure, whatever it is, should be organized to best carry out the strategies designed to achieve the organization's objectives and to provide the necessary information flow.

- The way management **assigns authority and responsibility** for operating activities affects the control environment because it determines how much initiative individuals are encouraged to use in solving problems and the limits of their authority. Delegation of authority means giving up centralized control of some of the business decisions and allowing those decisions to be made at lower levels in the organization by the people who are closest to the day-to-day operations of the business. This can help an organization to reduce defects in manufacturing, reduce cycle time or increase customer satisfaction, thereby increasing its competitiveness. However, the challenge is to delegate only to the extent required to achieve the organization's objectives. The delegation should be based on sound practices for identifying and minimizing risk and on weighing potential losses against potential gains from delegation. Increased delegation requires personnel with a higher level of competence and greater accountability. There should be effective monitoring by management of results, because the number of undesirable or unanticipated decisions may increase. The extent that individuals recognize that they will be held accountable for results greatly affects the control environment.
- **Human resource policies and practices** let employees know what levels of integrity, ethical behavior and competence are expected of them. These policies and practices include hiring, orientation, training, evaluating, counseling, promoting and compensating employees. All of these demonstrate the organization's commitment to hiring competent and trustworthy people, its expectations with respect to their performance and behavior, its commitment to advancing qualified personnel, and its desire to provide competitive compensation and incentives to motivate and reinforce outstanding performance. Policies with respect to remedial actions to be taken when necessary communicate to employees that violations of expected behavior will not be tolerated. Training needs to be ongoing.

Internal controls are more likely to function well if **management believes that the controls are important and communicates that support to employees at all levels**. If management believes controls are meaningless or even an obstacle, employees will pick up on this attitude. And in spite of formal policies saying otherwise, employees will then view internal controls as "red tape" to be "cut through" to get the job done.

Organizations with effective control environments set a positive "tone at the top."

- They **transmit guidance both verbally and by example**, communicating the entity's values, standards and code of conduct; and they follow up on violations. There are mechanisms to encourage employee reporting of suspected violations, and disciplinary actions are taken when employees fail to report them.
- They foster a "control consciousness" by setting formal and clearly communicated policies and procedures that are to be followed **at all times, without exception**, and which result in shared values and teamwork.
- They specify the **competence level needed for particular jobs**; hire and retain competent people; and assign authority and responsibility appropriately. Individuals who are working in positions that they are not qualified for are a risk simply because they are not capable of performing the work that they are supposed to. This provides an opportunity for someone else to take advantage of their lack of knowledge or skills in perpetrating fraud. For this reason, personnel policies and procedures are integral to an efficient control environment.

- The **board of directors** is responsible for setting corporate policy and for seeing that the company is operated in the best interest of shareholders, the owners. The attention and direction provided by the directors are critical. The board consists of both inside and outside directors who have adequate expertise and are active and involved. Independence of the board from management is critical, so that if necessary, difficult and probing questions will be raised.

A company's organizational structure is key to its ability to achieve its objectives, because the **organizational structure provides the framework for all its activities**. Aspects of establishing an organizational structure include:

- **Defining the key areas of authority and responsibility** and delineating lines for reporting.
- The company's organizational structure should be **whatever best suits its needs and will enable it to accomplish its objectives**. It may be centralized or decentralized. It may have direct reporting relationships or reporting may be more like a matrix. It may be organized by industry, product line, geographical location or distribution network, or it may be organized functionally.
- **Authority and responsibility should be delegated** to the extent necessary to achieve the organization's objectives.
- The control environment is influenced by the fact that all individuals in the organization realize that they will be held **accountable for their actions**. If a person does something that is in violation of the company's policies and standards, some sort of disciplinary action should be taken against that person. If there is no penalty for the violation of the internal controls of the company, then other individuals will not see the need for compliance.

Component 2: Risk Assessment

Within the control environment, **management is responsible for the assessment of risk**. A risk is anything that endangers the achievement of an objective. The questions should always be asked: *What could go wrong here? What assets do we need to protect?*

Risk assessment is the process of identifying, analyzing and managing the risks that have the potential to prevent the organization from achieving its objectives. Assessment of risk involves determining the dollar value of assets that are exposed to loss as well as the probability that a loss will occur. Management must determine how much risk it is willing to accept and then work to maintain within that level the amount of risk it accepts.

Therefore, the company's objectives must be established before the risks to them can be assessed. **Objective setting is therefore a key part of the management process of risk assessment**. Objectives may be explicitly stated or they may be implicit, such as to continue a previous level of performance. **Entity-level**, or company-level, **objectives** are often expressed through the company's strategic plan, which begins with its mission statement and addresses the long-term objectives of the organization. Strategic planning looks at the strategies as well as the organizational objectives and goals by examining both the **external** and **internal factors** that affect the company. The company's strengths and weaknesses as well as its opportunities and threats are assessed, and this process leads to the company's overall strategy.

This overall strategy then leads to more specific objectives that are established for specific activities such as sales, production and engineering. Specific activity-level objectives include goals relating to the product line, the company's market, its financing, and its profit goals. These specific objectives need to be consistent with one another and with the overall strategy and objectives.

When these entity-level and activity-level objectives have been set, the company can determine what its **critical success factors** are. We discussed critical success factors in Business Process Performance in Section C. **Critical success factors** are the aspects of the company's performance that are essential to its competitive advantage and therefore to its success. Therefore, they are **key things that must go right** if the company is to attain its objectives.

Broad categories of objectives, which also relate to the objectives of internal control, are:

- **Operations objectives** relate to the achievement of the company's mission. They include objectives for the effectiveness and efficiency of the company's operations and performance and profitability goals. They also include the safeguarding of company resources against loss. A company's operations objectives will vary depending on the choices management makes about structure and performance.
- **Financial reporting objectives** address the preparation of published financial statements. They include publishing reliable reports and prevention of fraudulent financial reporting. Companies need to achieve these objectives in order to meet their external obligations and requirements.
- **Compliance objectives** include adhering to all laws and regulations that the company is subject to. These laws and regulations establish minimum standards of behavior and may include marketing, packaging, pricing, taxes, environmental protection, employee safety and welfare, and international trade as well as many others. A company's record of compliance or noncompliance with laws and regulations affects its reputation in its communities. It also of course affects the company's risk of being the recipient of disciplinary procedures.

Objectives can overlap. For example, the operations objective of safeguarding resources includes prevention of loss through theft. However, the goal of ensuring reliable financial reporting includes making sure that any such losses that may occur through theft are properly reflected in the company's financial statements, a financial reporting objective.

Establishing these objectives is a required first step to establishing effective internal control, because it forms the basis for assessing risk, i.e., what could go wrong that could prevent the company from achieving its objectives.

Risk Identification

Risks can come from both internal and external factors that can affect the company's ability to achieve its objectives. The greater the difference in the current objectives from objectives of the past, the more risk there is. Even the objective of maintaining performance as it has been in the past carries both internal and external risks.

The risk assessment process should consider all risks that may occur. The risk assessment should be comprehensive and consider **all** significant interactions between the company and external parties. External parties to include in the assessment are suppliers (current and potential), investors, creditors, shareholders, employees, customers, buyers, intermediaries, competitors, public bodies and the news media.

Here are just a few examples of potential risks, both **internal** and **external**:

- **Internal risks** include employee embezzlement accompanied by falsification of records to conceal the theft, lack of compliance with government regulations or other illegal acts by employees, such as taking a bribe. They can include disruption in computer systems, poor management decisions, errors or accidents. Changes in management responsibilities can affect control activities; and an ineffective board or audit committee may leave openings for fraudulent actions.
- **External risks** include changes in technology, changes in the market in which an entity operates, actions taken by a competitor, new legislation bringing new requirements, natural disasters, economic changes, a failure of a key supplier, or being sued, defrauded, or robbed.

Risk Analysis

The risk assessment forms the basis for determining how the risks will be managed. After the company has identified its entity-level and activity-level risks, it should perform a risk analysis to (1) estimate the significance of each risk; (2) assess the likelihood or frequency of each risk's occurring; and (3) consider how each risk should be managed by assessing what actions need to be taken.

Risks that do not have a significant effect on the company and that have a low likelihood of occurring would not warrant serious concern. However, significant risks with a high likelihood of occurring usually require serious attention. Risks that are in between these two extremes require judgment.

Once the significance and likelihood of risks have been assessed, the following steps should be taken to manage the identified risks:

- 1) The amount of potential loss from each identified risk should be estimated to the extent possible. Some risks are indeterminate and can only be described as large, moderate or small.
- 2) Consider how each risk should be managed by determining what can be done and analyzing the costs, if any, associated with managing each risk. Some actions can virtually eliminate the risk or offset its effect if it does occur, such as hedging financial exposures or purchasing insurance. Some actions can reduce the level of risk but not eliminate it.
- 3) Procedures should be established to ensure that the plans for implementing the risk management are implemented. These procedures are the **control activities**, discussed in the next component.

Note: There is a difference between risk assessment, which is a function of internal control, and the plans or other actions taken by management to address the risks, which are a function of management and not of the internal control system.

Component 3: Control Activities

After the risks have been assessed, controls should be designed to limit the risk. To accomplish this, **control activities** are implemented. Control activities are the **policies that address the identified risks and procedures that ensure that management directives are carried out**, thus helping ensure that the organization's objectives will be achieved.

Therefore, controls should be designed to limit risk wherever risk exposure is determined to exist, in order to protect the organization's ability to achieve its objectives.

This risk could be in the form of loss of assets, or it could be a misstatement of accounting or management information. The identified risks cannot be completely eliminated, but designing appropriate control activities and ensuring that those control activities are implemented can minimize them.

In addition, management must comprehend laws and regulations imposed on the organization from the outside and ensure that compliance policies and procedures are in place.

Classifications of Control Activities

There are five classifications of control activities based on when they occur within the activity being carried out and what their objective is. The types of controls and examples of them are:

Type of Control	Meaning	Example(s) of Control
Preventive	To avoid the occurrence of an unwanted event	• Segregation of duties, • Suitable authorization of transactions, • Checking creditworthiness of customers before shipping goods. • Physical controls to safeguard assets such as equipment, inventories, securities, cash and other assets.
Detective	To detect (discover) an unwanted event that has already occurred	• Bank reconciliations and regular reconciliations between other physical assets and amounts shown on control records. • Checking for missing document numbers in pre-numbered documents. • Top-level reviews of performance reports with variances from budgets, forecasts, prior periods and competitors. • Managers of various activities review direct functional performance reports.
Directive	To ensure (encourage) the occurrence of a desirable event	Managers of a construction company instructing project managers to hire local workers in order to create a favorable image in the communities in which it operates.
Corrective	To correct an undesirable event that has already occurred	Procedures put in place to remedy problems discovered by detective controls, such as steps taken to identify the cause of the problem, to correct errors arising from the problem, and to modify the processing system to minimize future occurrences of the problem.
Compensating	To compensate for an internal control weakness by doing more of other controls	A bank reconciliation may be a compensating control as well as a detective control, because it can compensate for flaws in the controls that are typically established over the receipts or disbursement processes.

Additionally, control activities can be grouped according to the three categories of **objectives**:

- 1) Financial reporting,
- 2) Operations, and
- 3) Compliance.

Examples of control activities are:

- 1) **Top level reviews:** Reviewing actual results versus budgets, forecasts, prior periods and competitors; tracking the extent to which targets are being met and plans are being implemented.
- 2) **Direct functional or activity management:** Managers who direct functions review appropriate performance reports, such as collections of past-due accounts.
- 3) **Information processing:** Controls to check accuracy, completeness and authorization of transactions; control of new system development and existing system modifications; control of access to data files and programs.
- 4) **Independent checks:** Checks performed by someone other than the person responsible for the original operation are generally more effective at assuring that transactions are processed and activities are performed accurately. A "new pair of eyes" will spot mistakes more often than those of the originator of the work.
- 5) **Performance indicators:** Performance indicators include relating different sets of data to one another and investigating unexpected results. The data may be operating or financial data. Performance indicators would include purchase price variances, percentage of returns to total orders, etc. By investigating unexpected results, management can see areas where the organization's objectives are in danger of not being achieved.
- 6) **Physical controls to safeguard assets:** The most visible **safeguarding controls** include controls to protect the organization's assets from losses due to natural disasters like floods and tornadoes. However, **safeguarding controls** also include physical protection measures to restrict access to assets and documents such as records and blank checks, purchase orders, bank codes, etc., to authorized personnel. Inventory, equipment, securities, cash and other assets must be physically secured to safeguard them. Access to warehouses and inventory storage areas should be restricted to authorized individuals. Items must be counted periodically and compared with control records.
- 7) **Documents and records:** Source documents are designed to facilitate collection of all relevant information; audit trails should be maintained. Source documents should be pre-numbered in order to account for all documents, reducing the likelihood of fraudulent use.
- 8) **Authorization:** Employees should be appropriately empowered to perform tasks, receive specific documents and make decisions that impact assets. Their authority must involve some kind of validation such as signature or authorization.
- 9) **Segregation of duties:** Duties should be divided among different people. This reduces the risk of error or inappropriate activities. It ensures that no individual is given so much responsibility that he or she is in a position to both **perpetrate** and **conceal** an irregularity. Responsibility for authorizing transactions, recording them and handling the related asset should be segregated. For example, the manager of the credit department who authorizes credit sales should not also be responsible for recording accounts receivable transactions or handling cash receipts. Though **segregation of duties** is listed last, it is perhaps one of the most important internal controls for the Exam. Therefore, it will be discussed in more detail later.

Component 4: Information and Communication

Relevant information must be identified, captured and communicated in a manner that enables people to carry out their responsibilities. This means reports must contain the information that management needs and must be available in a timely manner for management to be able to act on that information.

- 1) Communication must be **ongoing**, both within and between various levels and activities of the organization. This starts with communication by top management to the rest of the organization.
- 2) All **staff** must understand their roles in the internal control system and be able to **communicate significant information upstream**.
- 3) Reports containing operational, financial and compliance information required for informed decisions – both internally generated and external information – must be available.
- 4) Supervisors must communicate duties and responsibilities to the employees that report to them, and employees must alert management to potential problems as soon as they arise or become apparent.
- 5) Some information must be communicated to those outside the organization, such as vendors, and must also be available from external sources.

Some examples of information that is essential are:

- 1) Financial information is used internally to monitor performance for the purpose of making operating decisions and allocating resources, in addition to its use in developing financial statements for external financial reporting.
- 2) Operating information is required on purchases, sales and other transactions as well as competitors' actions, product releases, and economic conditions. Other operating information might be needed to achieve compliance, such as personnel reports and emissions information.

Some examples of communication that must take place are:

- 1) Information systems must provide reports to appropriate personnel so they can carry out their responsibilities.
- 2) All personnel need to receive clear communication from top management that their internal control responsibilities must be taken seriously. Each person needs to understand his or her role in the internal control system and how the system works. People need to understand that when something unexpected occurs, attention must be given to the **cause** of the event as well as to the event itself. If this is not done, a potential weakness in the system may go unidentified. Weaknesses must be identified and action taken to prevent another occurrence.
- 3) People need to know what behavior is expected of them and what behavior is unacceptable. For example, the information must be communicated that it is not acceptable to "meet the budget" by the use of "creative accounting" or other fraudulent activities.
- 4) Employees need to know that if they report a suspected violation of the company's code of conduct, they will not get into trouble for it. This is what is known as "whistle-blower" protection. A "whistle-blower" is someone who "blows the whistle" to alert management to something going on that is not proper. If protection for whistle blowers is not in place, they may not come forward because of fear of reprisal, and an opportunity to learn about something important may be missed.
- 5) In addition, communications between management and the Board of Directors are vital. Senior management must inform board members about performance, new developments, major initiatives, potential risks, and any other relevant information. The Board needs this information in order to be effective at carrying out its oversight responsibilities and in providing advice and counsel. The Board also needs to communicate to management what information it needs.

- 6) Appropriate communication is also needed with those who are outside of the organization. Communications from outside parties such as external auditors can provide important information about the functioning of the internal control system. Banks and insurance companies are subject to examinations and compliance reviews that can bring their attention to control weaknesses. Customer communications about shipping, billing and other operating activities may point out operating problems that need to be addressed.
- 7) Any outsider dealing with the company must be informed that improper actions such as kickbacks or other improper incentives from vendors will not be tolerated.

Means of Communication

Communication can take place by many means. Some of the means are policy manuals, emails, bulletin board notices, and information transmitted orally during group meetings or one-on-one meetings. Actions also communicate. The way managers behave in the presence of their subordinates can communicate more powerfully than any words.

Component 5: Monitoring

Finally, **management must monitor** the entire internal control system. Monitoring assesses the quality of the internal control system's performance **over time**. Management must also revisit previously identified problems to make sure they have been corrected.

Monitoring ensures that the internal control system continues to operate effectively. Systems and procedures change over time, and the way controls are applied need to change in order to continue to be effective. Management needs to determine whether the internal control system is still relevant and whether it is still able to address new risks that may have developed.

Monitoring can be done in two ways: (1) through **ongoing monitoring** during normal operations, and (2) **separate evaluations** by management with the assistance of the internal audit function. If monitoring is done regularly during normal operations, it lessens the need for separate evaluations.

Note: Monitoring should be done on a regular basis. An advantage to ongoing monitoring is that if operating reports are used to manage ongoing operations, exceptions to anticipated results will be recognized quickly.

When deficiencies in internal control are discovered, they should be reported immediately to top management and, for very significant matters, to the board of directors. Appropriate remedial action should be taken, and the results of the remedial action should also be monitored to be certain that the situation is corrected.

Question 163: Monitoring is an important component of internal control. Which of the following items would **not** be an example of monitoring?

- a) Management has asked internal auditing to perform regular audits of the controls over cash processing.
- b) Data processing personnel regularly reconcile batch control totals for items processed with batch controls for items submitted.
- c) Data processing management regularly generates exception reports for unusual transactions or volumes of transactions and follows up with investigation as to causes.
- d) Management regularly compares divisional performance with budgets for the division.

(CIA Adapted)

Segregation of Duties

Duties need to be divided among various employees to reduce the risk of errors or inappropriate activities. This ensures that no single individual is given too much responsibility **so that no employee is in a position to both perpetrate and conceal irregularities.**

Note: **Different people must always perform the following four functions:**

- 1) **Authorizing** a transaction.
- 2) **Recording** the transaction, preparing source documents, maintaining journals.
- 3) Keeping **physical custody** of the related asset – for instance, receiving checks in the mail.
- 4) The **periodic reconciliation** of the physical assets to the recorded amounts for those assets.

In a question about an effective or ineffective internal control, keep in mind that these four things must be done by different people.

Examples of segregation of duties:

- One person has custody of cash receipts, while a different person has the authority to authorize account write-offs. (Without segregation, one person could authorize a false write-off while diverting the collection on the account.)
- One person authorizes issuance of purchase orders, while a different person is responsible for recording receipt of inventory. (Without such segregation, one person could issue a purchase order to a fictitious vendor using a post office box personally rented for the purpose, then prepare a fictitious receiving record and mail an invoice to the company using the personal post office box, resulting in the company's paying for something it never ordered or received.)
- One person has authority to adjust accounts receivable, while a different person posts payments on customer accounts. (Without segregation here, one person could divert cash receipts and then falsify the account balances of the customers who paid the cash in order to conceal the diversion.)
- One person is responsible for preparing the bank deposit, while a different person reconciles the checking account. (Without segregation, one person could divert cash receipts and cover the activity by creating "reconciling items" in the account reconciliation.)

Be aware, however, that segregation of duties does not guarantee that fraud will not occur. Two or more employees could collude with one another to commit fraud, covering for one another and, presumably, sharing the proceeds.

Note: **Collusion** occurs when two or more individuals work together to overcome the internal control system and perpetrate a fraud. When two or more people work together, they are able to get around the segregation of duties that may have been set out.

Question 164: The proper segregation of duties requires that:

- a) The individual who records a transaction does not compare the accounting records with the asset itself.
- b) The individual who records a transaction must maintain custody of the asset resulting from the transaction.
- c) The individual who authorizes a transaction also records it.
- d) The individual who maintains custody of an asset must have access to the accounting records for the asset.

(CMA Adapted)

Question 165: In a well designed internal control system, two tasks that should be performed by different people are:

- a) Posting of amounts from both the cash receipts journal and cash payments journal to the general ledger.
- b) Distribution of payroll checks and approval of sales returns for credit.
- c) Approval of bad debt write-offs, and reconciliation of the accounts payable subsidiary ledger and controlling account.
- d) Reconciliation of bank account and recording of cash receipts.

(CMA Adapted)

Question 166: An auditor noted that the accounts receivable department is separate from other accounting activities. A separate credit department approves credit. Control accounts and subsidiary ledgers are balanced monthly. Similarly, accounts are aged monthly. The accounts receivable manager writes off delinquent accounts after 1 year, or sooner if a bankruptcy or other unusual circumstances are involved. Credit memoranda are pre-numbered and must correlate with receiving reports. Which of the following areas could be viewed as an internal control weakness of the above organization?

- a) Credit approvals.
- b) Monthly aging of receivables.
- c) Write-offs of delinquent accounts.
- d) Handling of credit memos.

(CIA Adapted)

Question 167: One characteristic of an effective internal control structure is the proper segregation of duties. The combination of responsibilities that could be performed by the same person is:

- a) Preparation of paychecks and check distribution.
- b) Timekeeping and preparation of payroll journal entries.
- c) Signing of paychecks and custody of blank payroll checks.
- d) Approval of time cards and preparation of paychecks.

(CMA Adapted)

Question 168: One payroll audit objective is to determine if there is proper segregation of duties. Which of the following activities should not be performed by the same person?

- a) Hiring employees and authorizing changes to pay rates.
- b) Preparing attendance data and preparing the payroll.
- c) Signing and distributing payroll checks.
- d) Preparing the payroll and filing payroll tax forms.

(CIA Adapted)

Responsibilities of the Board of Directors

The board of directors of a company is responsible for ensuring that the company is operated in the best interest of the shareholders, who are the owners of the company. Thus, the members of the board of directors represent the owners of the company. The board's responsibility is to provide governance, guidance and oversight to the management of the company. The board has the following specific responsibilities:

- Selecting management. Officers of the company are elected by the board of directors.
- Because it elects the company's management, the board determines what it expects from management in terms of integrity and ethics and it confirms its expectations in its oversight activities.
- The board has authority in key decisions and plays a role in top-level strategic objective-setting and strategic planning.
- Because of its oversight responsibility, the board is closely involved with the company's internal control activities.
- Board members need to be familiar with the company's activities and environment, and they need to commit the time required to fulfill their board responsibilities, even though they may be outside, independent directors.
- Board members should investigate any issues they consider important. They must be willing to ask the tough questions and to question management's activities. They must have access to the necessary resources to do this and must have unrestricted communications with all company personnel – including the internal auditors – as well as with the company's external auditors and its legal counsel.
- Because board members are responsible for questioning and scrutinizing management's activities, it is important that the board have members who are independent of the company. An independent director has no material relationship with the company. Therefore, an independent director is not an officer or employee of the company and thus is not active in the day-to-day management of the company. Boards of companies that are listed on secondary securities markets such as the New York Stock Exchange are required to be made up of a majority of independent directors.

Most boards of directors carry out their duties through committees. Committees of the board of directors are made up of selected board members and are smaller, working groups of directors that are tasked with specific oversight responsibilities. One of the committees whose membership is prescribed by SEC regulations is the audit committee. Other usual committees are compensation, finance, nominating and employee benefits. All of the committees of the board of directors are important parts of the company's internal control system, as their members can bring specific internal control guidance in their specific areas of responsibility.

The responsibilities of the audit committee are particularly critical. Furthermore, the requirements for serving on an audit committee of a publicly-held company have been formalized in law and regulations, first by the Sarbanes-Oxley Act of 2002 and then, as directed by Sarbanes-Oxley, in SEC regulations. Secondary securities markets also include audit committee requirements in their listing requirements.

Audit Committee Requirements, Responsibilities and Authority

Audit committees of the boards of directors of corporations were first recommended by the SEC in 1972. Within short order, stock exchanges began requiring or at least recommending that listed companies have audit committees. The responsibilities of audit committees have been increased over the years and have been formalized by statute.

In 1987, the Treadway Commission made six recommendations for audit committees in their study aimed at identifying the causes of fraudulent financial reporting and making recommendations to reduce its incidence.

In 1999, the chairmen and CEOs of the New York Stock Exchange and the National Association of Securities Dealers sponsored a committee, called the Blue Ribbon Committee (BRC) that was tasked with making recommendations for improving audit committees' effectiveness. The report of the Blue Ribbon Committee made ten recommendations for improving the effectiveness of audit committees and provided five guiding principles for audit committees to follow in developing policies for their companies. The BRC recommendations were adopted by the New York Stock Exchange, the American Stock Exchange, the NASDAQ, and the SEC.

The Sarbanes-Oxley Act of 2002 increased audit committees' responsibilities to a great degree. It also increased the qualifications required for members of audit committees, and it increased the authority of audit committees. In response to the Sarbanes-Oxley Act, the stock exchanges and the SEC developed new rules and regulations for the purpose of strengthening audit committees.

According to the New York Stock Exchange, the audit committee "stands at the crucial intersection of management, independent auditors, internal auditors and the board of directors." Because of this, the requirements for and responsibilities of members of audit committees of public companies' boards of directors are highly regulated. The requirements for the audit committee are reviewed here in some detail, not because you need to memorize them (although you should be very familiar with them); but in order to emphasize the magnitude and the importance of the audit committee's function and responsibilities.

Requirements for Audit Committee and Audit Committee members:

- The audit committee is to consist of at least three members. This is a listing requirement of the New York Stock Exchange and other stock exchanges.
- All members of the audit committee must be **independent** per Section 10A 3(b)(3) of the Securities Exchange Act of 1934 (15 U.S.C. 78f), as amended. The section defines independence this way: "In order to be considered to be independent . . . a member of an audit committee of an issuer may not, other than in his or her capacity as a member of the audit committee, the board of directors, or any other board committee-- "(i) accept any consulting, advisory, or other compensatory fee from the issuer; or "(ii) be an affiliated person of the issuer or any subsidiary thereof." In other words, the members of the audit committee **may not be employed** by the company in any capacity if they serve as members of its audit committee.
- In addition, the New York Stock Exchange requires a five-year "cooling-off" period for former employees of a listed company, or of its independent auditor, before they can serve on the audit committee of the listed company.
- One member of the audit committee must have **accounting or financial management expertise**. This is a requirement made by stock exchanges. The Sarbanes-Oxley Act requires that if the audit committee does **not** include a financial expert, this fact must be disclosed.
- **All** members of the audit committee must be financially literate at the time of their appointment or must become financially literate within a reasonable period of time after their appointment to the audit committee. This is a listing requirement of the New York Stock Exchange and other stock exchanges.

Responsibilities of the Audit Committee:

- Rule 10A 3(b)(2) of the Securities Exchange Act of 1934 (15 U.S.C. 78f) sets forth the following responsibilities of the audit committee: "The audit committee of each issuer, in its capacity as a committee of the board of directors, shall be directly responsible for the appointment, compensation, and oversight of the work of any registered public accounting firm employed by that issuer (including resolution of disagreements between management and the auditor regarding financial reporting) for the purpose of preparing or issuing an audit report or related work, and each such registered public accounting firm shall report directly to the audit committee." The audit committee is responsible for selecting and nominating the external auditor, approving audit fees, supervising the external auditor, overseeing auditor qualifications and independence, discussing with the auditors matters required under generally accepted auditing standards, and reviewing the audit scope, plan and results.
- The New York Stock Exchange's Listing Manual requires that listed companies have an **audit committee charter** "which addresses the committee's purpose – which, at minimum, must be to: (A) assist board oversight of (1) the integrity of the listed company's financial statements, (2) the listed company's compliance with legal and regulatory requirements, (3) the independent auditor's qualifications and independence, and (4) the performance of the listed company's internal audit function and independent auditors; and (B) prepare an audit committee report as required by the SEC to be included in the listed company's annual proxy statement."
- Rule 10A 3(b)(4) of the Securities Exchange Act specifies that "each audit committee shall establish procedures for (A) the receipt, retention, and treatment of complaints received by the issuer regarding accounting, internal accounting controls, or auditing matters; and (B) the confidential, anonymous submission by employees of the issuer of concerns regarding questionable accounting or auditing matters."
- Rule 10A 3(b)(5) of the Securities Exchange Act provides that "each audit committee shall have the authority to engage independent counsel and other advisers, as it determines necessary to carry out its duties."
- The New York Stock Exchange Listing Manual further specifies that the duties and responsibilities of the audit committee must include "those set out in Rule 10A-3(b)(2), (3), (4) and (5) of the Exchange Act, as well as to: (A) at least annually, obtain and review a report by the independent auditor describing: the firm's internal quality-control procedures; any material issues raised by the most recent internal quality-control review, or peer review, of the firm, or by any inquiry or investigation by governmental or professional authorities, within the preceding five years, respecting one or more independent audits carried out by the firm, and any steps taken to deal with any such issues; and (to assess the auditor's independence) all relationships between the independent auditor and the listed company." After reviewing the independent auditor's report, "the audit committee will be in a position to evaluate the auditor's qualifications, performance and independence. This evaluation should include the review and evaluation of the lead partner of the independent auditor. In making its evaluation, the audit committee should take into account the opinions of management and the listed company's internal auditors (or other personnel responsible for the internal audit function). In addition to assuring the regular rotation of the lead audit partner as required by law, the audit committee should further consider whether, in order to assure continuing auditor independence, there should be regular rotation of the audit firm itself. The audit committee should present its conclusions with respect to the independent auditor to the full board."
- In addition, the New York Stock Exchange specifically requires the following:
 - That audit committees in listed companies review the annual and quarterly financial statements and the Management Discussion & Analysis section of the annual report. The audit committee is to discuss these reports with management and the independent auditors and review earnings press releases and earnings guidance provided to analysts and rating agencies. They are also to discuss with management their guidelines and policies that govern the process of risk assessment and risk management.

- That the audit committee meet periodically and separately with management and with internal auditors and independent auditors in order to uncover issues warranting committee attention.
- That the audit committee review with the independent auditor any audit problems or difficulties, including any restrictions on the scope of the independent auditor's activities or on access to requested information, and any significant disagreements with management and management's response.
- That the audit committee set clear hiring policies for employees or former employees of the independent auditors, taking into account the pressures that may exist for auditors consciously or subconsciously when seeking a job with the company they audit.
- That the audit committee report regularly to the full board of directors to review any issues that arise with respect to the quality or integrity of the listed company's financial statements, the company's compliance with legal or regulatory requirements, the performance and independence of the company's independent auditors, or the performance of the internal audit function.
- And finally, that the audit committee "review: (A) major issues regarding accounting principles and financial statement presentations, including any significant changes in the company's selection or application of accounting principles, and major issues as to the adequacy of the company's internal controls and any special audit steps adopted in light of material control deficiencies; (B) analyses prepared by management and/or the independent auditor setting forth significant financial reporting issues and judgments made in connection with the preparation of the financial statements, including analyses of the effects of alternative GAAP methods on the financial statements; (C) the effect of regulatory and accounting initiatives, as well as off-balance sheet structures, on the financial statements of the listed company; and (D) the type and presentation of information to be included in earnings press releases (paying particular attention to any use of 'pro forma,' or 'adjusted' non-GAAP, information), as well as review any financial information and earnings guidance provided to analysts and rating agencies."
- The Blue Ribbon Committee report recommended that the audit committee monitor the company's internal control processes, and most audit committees do this. They oversee the internal audit function and monitor internal control systems for compliance with legal and regulatory requirements.

Authority of the Audit Committee:

- Rule 10A-3(b)(6) of the Securities Exchange Act provides that "each issuer shall provide for appropriate funding, as determined by the audit committee, in its capacity as a committee of the board of directors, for payment of compensation (A) to the registered public accounting firm employed by the issuer for the purpose of rendering or issuing an audit report; and (B) to any advisers employed by the audit committee under paragraph (5)."
- The audit committee has the authority to investigate any matter.

Legislative Initiatives on Internal Control

We have already referred to the Sarbanes-Oxley Act of 2002, and we will discuss it in more detail later. Before Sarbanes-Oxley, though, the Foreign Corrupt Practices Act (FCPA) dealt with public and non-public companies' internal controls.

Foreign Corrupt Practices Act (FCPA)

The Foreign Corrupt Practices Act of 1977 (substantially revised in 1988) was enacted in response to disclosures of questionable payments that had been made by large companies. Investigations by the SEC had revealed that over 400 U.S. companies had made questionable or illegal payments in excess of \$300 million to foreign government officials, politicians and political parties. The payments were either illegal political contributions or payments to foreign officials that bordered on bribery.

The FCPA is an amendment to the 1934 Securities Exchange Act and is administered by the SEC.

The FCPA has two main provisions: 1) **anti-bribery provisions**, and 2) **accounting provisions**.

Anti-Bribery Provisions

The **anti-bribery provisions of the FCPA apply to all companies**, regardless of whether they have stock registered with the SEC.

The FCPA makes it illegal to offer or authorize corrupt political payments (bribes) to any foreign official, foreign party chief or official or a candidate for political office in a foreign country, or to make corrupt payments through an intermediary while knowing that all or part of the payment will go to a foreign official.

Note that this prohibition is only against corrupt payments to a **foreign official, a foreign political party or party official, or any candidate for foreign political office**.

Note: A **corrupt payment** is one that intends to cause the recipient to misuse his or her official position in order to wrongfully direct business to the payer, *whether or not the payment succeeds in its purpose*.

Under the act, **it is illegal for any company or anyone acting on behalf of a company to bribe any foreign official in order to obtain or retain business**. In addition, a firm – or an individual acting on behalf of a firm – will be held criminally liable if it makes payments to a third party with the knowledge that those payments will be used by the third party as bribes.

The responsibility to insure that all payments are acceptable is given to the company as whole and not to any individual or position within the company, although individuals are personally liable nonetheless for their own actions. The company must ensure that all transactions are in accordance with management's general, or specific, authorization and are recorded properly.

Accounting Provisions

The **accounting and record-keeping provisions of the act apply only to companies that are regulated by the SEC**.

Under the Foreign Corrupt Practices Act, corporate management is required to maintain books, records and accounts that accurately and fairly reflect transactions **and to develop and maintain a system of internal accounting control**.

The internal control requirements were included in the act because of the fundamental premise that effective internal control should provide a deterrent to illegal payments.

Note: The accounting and record-keeping provisions **apply to all U.S. companies that are regulated by the SEC**, not only those with foreign operations. This includes all publicly-held companies, as well as companies that are privately-held but have voluntarily registered with the SEC.

Question 169: The Foreign Corrupt Practices Act of 1977 placed responsibility to devise and maintain adequate internal control with the:

- a) Director of the internal auditing function.
- b) Board of directors.
- c) Chief executive officer.
- d) Company as a whole with no designation of specific persons or positions.

(CMA Adapted)

The penalties for making an illegal payment are potentially very severe against either the company, the person making or authorizing the payment, or both.

- Fines of up to \$2 million may be levied against the company;
- Civil penalties of up to \$10,000 against the firm and/or any individual may also apply;
- The Securities Exchange Commission (SEC) may levy monetary fines;
- The company can be suspended or barred from participation in government contracts;
- The company can have its export license privileges revoked or suspended;
- The company could incur shareholder lawsuits and/or sustain long-term damage to its reputation; and
- Any individual making or authorizing an illegal payment may be personally fined up to \$100,000, imprisoned for up to 5 years, or both.

Sarbanes-Oxley Act

On July 30, 2002, the Sarbanes-Oxley Act of 2002 (called SOX or SarbOx for short) was enacted in response to several incidents of financial reporting fraud and audit failures. This act has been called the most significant securities legislation since 1940. Many of the act's provisions apply to internal control, particularly the provisions regarding the audit committee of the board of directors.

The Sarbanes-Oxley Act applies to all publicly-held companies in the U.S., all of their divisions, and all of their wholly-owned subsidiaries. It also applies to any non-U.S. owned publicly-held multinational company that engages in business in the U.S. A privately-held company may also comply with SOX in preparation for an initial public offering, in preparation for raising private funding, or on a voluntary basis using it as a best practices benchmark.

Public Company Accounting Oversight Board (PCAOB)

Title 1 of the Sarbanes-Oxley Act established the Public Company Accounting Oversight Board (PCAOB) to oversee the auditing of public companies that are subject to the securities laws. The PCAOB has many responsibilities, and its role in providing guidance to auditors on their auditing of internal controls is just one small part of those responsibilities.

The Board is charged with overseeing the audits done by public accounting firms. The five Board members are appointed by the SEC. The Board members must be financially literate and must be from the private sector. Two of the members must be or have been certified public accountants. The remaining three must **not** be and **cannot have been** CPAs. The Chair may be held by one of the CPA members only if that member has not been a practicing CPA for five years.

The PCAOB is headquartered in Washington, D.C. and has regional offices throughout the United States. As provided in the Sarbanes-Oxley Act, the Board's operations are funded by "accounting support fees" paid by issuers of securities that are registered with the SEC and other companies that are required to file reports with the SEC, as well as by registration and annual fees paid by public accounting firms.

The responsibilities of the PCAOB include:

- Registering public accounting firms that audit public companies. The Sarbanes-Oxley Act requires all accounting firms (both U.S. firms and non-U.S. firms) that prepare or issue audit reports on or participate in audits of U.S. public companies to register with the PCAOB.
- Establishing auditing and related attestation, quality control, ethics, independence and other standards relating to the preparation of audit reports for issuers.
- Conducting inspections of registered public accounting firms, annually for firms that audit more than 100 issuers and every three years for others. In the inspections, the Board assesses the firm's compliance with the Sarbanes-Oxley Act, the rules of the Board, the rules of the Securities and Exchange Commission, and its professional standards in connection with the firm's performance of audits, issuance of audit reports, and related matters involving issuers.
- Enforcing compliance with the Act, the rules of the Board, professional standards, and securities laws relating to audit reports and the obligations of accountants for them.
- Conducting investigations and disciplinary proceedings and imposing appropriate sanctions. The PCAOB is authorized to conduct investigations concerning any acts or practices, or omissions to act, by registered public accounting firms and/or persons associated with such firms that may violate any provision of the Sarbanes-Oxley Act, the rules of the Board, the provisions of the securities laws relating to the preparation and issuance of audit reports, or professional standards.

If violations are detected, the Board provides an opportunity for a hearing and may impose sanctions designed to deter a possible recurrence and to enhance the quality and reliability of future audits. The sanctions may be as severe as revoking a firm's registration or barring a person from participating in audits of public companies. Lesser sanctions include monetary penalties and requirements for remedial measures, such as training, new quality control procedures, and the appointment of an independent monitor.

For some interesting reading that will help you to understand the standards to which auditors are held by the PCAOB, visit its website at www.pcaobus.org, click on "Enforcement" and then on "Disciplinary Proceedings."

- Management of the operations and staff of the Board.

Major Internal Control Provisions of Sarbanes-Oxley

The major internal control provisions of the Sarbanes-Oxley Act are in Sections 302 and 404.

Section 302 – Corporate Responsibility for Financial Reports

Each annual or quarterly report that is filed or submitted in accordance with the Securities Exchange Act of 1934 (in other words, SEC reports) must include certifications by the principal executive officer(s) and the principal financial officer(s) that:

- The signing officer has **reviewed** the report;
- The report does not contain any untrue material statement or omit to state any material fact that could cause the report to be misleading;
- Based on the officer's knowledge, the financial statements and all the other related information in the report fairly present in all material respects the financial condition and results of operations of the company for all of the periods presented in the report;

- The signing officers:
 - Are responsible for establishing and maintaining internal controls;
 - Have designed the internal controls to ensure they are made aware of all material information relating to the company and all subsidiaries;
 - Have evaluated the effectiveness of the company's internal controls within the previous ninety days; and
 - Have reported on their findings about the effectiveness of their internal controls.
- The signing officers have disclosed to the company's auditors and its audit committee of the board of directors:
 - All deficiencies in the design or operation of the company's internal controls and have identified for the company's auditors any material weaknesses in its internal controls; and
 - Any fraud, regardless of how material it is or is not, that involves management or other employees who have a significant role in the company's internal controls; and
- The signing officers have stated in their report whether or not there were any significant changes in internal controls or in any other factors that could have a negative impact on the company's internal controls after the date of their evaluation, including any corrective actions that have been taken with regard to deficiencies or material weaknesses.

Furthermore, companies cannot avoid these requirements by reincorporating outside the United States or by transferring their company's activities outside of the United States. If they do this, the Act will continue to have full legal force over them.

Section 404 – Management Assessment of Internal Controls

Each annual report required by the SEC must contain an assessment by management of the adequacy of the company's **internal control over financial reporting** (ICFR for short). This is a requirement of Section 404(a) of the Sarbanes-Oxley Act. This internal control report shall:

- State the responsibility of management for establishing and maintaining an adequate internal control structure and procedures for financial reporting; and
- Contain an assessment of the effectiveness of the internal control structure and procedures of the company for financial reporting as of the end of its most recent fiscal year.

Guidance for the management assessment of internal controls is provided by the SEC. In June 2007, the SEC published Release No. 33-8810, containing the interpretive guidance for management on Section 404. The guidance was intended to enable companies to implement the requirements more effectively and efficiently.

Initially, the management assessment of internal controls provision of Sarbanes-Oxley (SOX 404) was required only of large publicly-held companies. However, after the SEC's interpretive guidance was released, smaller public companies that were not accelerated filers were also required to document their management assessment of internal controls over financial reporting for fiscal years ending after December 15, 2007.

The SEC approved the guidance as an interpretive release rather than as a commission rule, in order that companies that already had established and effective processes would **not** have to alter their existing procedures to align them with the new guidance and also in order to allow the SEC to more easily update or amend the guidance as needed.

The SEC guidance is organized around **two broad principles**:

- 1) Management should determine whether it has implemented controls that **adequately address the risk that a material misstatement of the financial statements would not be prevented or detected in a timely manner**. Management is not required to identify every control in a process but can focus its evaluation and its documentation supporting its assessment on the controls that it has determined will adequately address the risk of a material misstatement of the financial statements.
- 2) Management's evaluation of evidence about the operation of its controls should be based on its **assessment of risk**. An approach is provided for making risk-based judgments about the evidence needed for the evaluation. This allows management to concentrate on areas of financial reporting that pose the highest risk of a material misstatement.

This interpretive guidance clarified for management where the focus of its internal control evaluation should be: on whether it has put into place controls that adequately address the risk that a **material misstatement of the financial statements would not be prevented or detected in a timely manner**. Management is not required to identify every control in every process or to document all of the business processes impacting its internal control over financial reporting.

The guidance also clarified that **management's evaluation of evidence about its controls should be based on its assessment of risk**. In low-risk areas, management can use more efficient approaches to gathering evidence while performing more extensive testing in high-risk areas. Management is thus able to concentrate its resources on those areas of financial reporting that pose the highest risks to reliable financial reporting.

Section 404(b) of the Sarbanes-Oxley Act requires the company's independent auditor to report on and attest to management's assessment of the effectiveness of the internal controls. The independent auditor's objective in an audit of internal control over financial reporting is to express an opinion on the effectiveness of the company's internal control over financial reporting. This is considered to be the core responsibility of the auditor and an integral part of the audit report. Auditors are guided in their attestation to management's assessment of internal controls by the Public Company Accounting Oversight Board's (PCAOB's) Auditing Standard No. 5 issued on June 12, 2007.

Management in its assessment of internal controls and the independent auditor in its attestation to management's assessment can have different testing approaches, because their roles are different and they are subject to different guidance. However, the PCAOB intentionally aligned its guidance in Auditing Standard No. 5 with the SEC's guidance for management in SEC Release 33-8810, particularly with regard to prescriptive requirements, definitions, and terms. Both SEC Release 33-8810 and the PCAOB's Auditing Standard No. 5 have the effect of efficiently focusing Section 404 compliance on the most important matters affecting investors.

PCAOB Preferred Approach to Auditing Internal Controls in Auditing Standard No. 5

PCAOB Auditing Standard No. 5 and also SEC Release 33-8810 call for a **top-down, risk-based approach** to assessing and attesting to internal controls.

In both, a risk-based approach begins by **identifying the risks** that a material misstatement of the financial statements would not be prevented or detected in a timely manner. Beginning with risk assessment allows the auditor to focus on higher-risk areas while spending less time and effort on areas of lower risk. The auditor should test those controls that are important to the auditor's conclusion about whether the company's controls sufficiently address the assessed risk of misstatement to each relevant assertion.

The independent, external auditor is required to provide an independent opinion on the effectiveness of the company's internal control over financial reporting. However, the auditor is not familiar with the company's controls the way management is and does not interact with or observe the operation of the controls the way management does. Therefore, the auditor cannot obtain sufficient evidence to support an opinion on the effectiveness of internal control based solely on observation of or interaction with the company's controls.

Thus, PCAOB Auditing Standard 5 states that the auditor should perform procedures such as **inquiry, observation, and inspection of documents, or walkthroughs – which consist of a combination of the preceding procedures** – in order to fully understand and identify the likely sources of potential misstatements, whereas management might be aware of those risk areas on an on-going basis.

In performing a **walkthrough**, the auditor follows a single transaction from its origination all the way through the company's processes, including information systems, until it is reflected in the company's financial records, using the same documents and information technology that company personnel use. The objectives of a walkthrough are to

- Obtain a complete understanding of the flow of transactions and to determine the points in the process at which misstatements could occur;
- Confirm the auditor's understanding of the design of controls in that process;
- Evaluate the effectiveness of the design of controls; and
- Determine whether controls have been placed in operation.

Focusing on a single transaction from start to finish is generally the most effective and efficient way to accomplish these objectives.

Walkthrough procedures usually include a combination of **inquiry, observation, inspection of relevant documentation, and re-performance of controls**.

At the points where important processing procedures occur, the auditor should question the company's personnel about their understanding of what is required by the company's prescribed procedures and controls. These questions, combined with the other walkthrough procedures, allow the auditor to gain enough understanding of the process to be able to identify important points at which a necessary control may be missing or not designed effectively. The auditor should ask probing questions that go beyond a narrow focus on the single transaction used as the basis for the walkthrough. Probing questions allow the auditor to gain an understanding of the different types of significant transactions handled by the process.

Some high-risk areas, especially areas such as the formulation of accounting estimates that are easily manipulated in spite of controls, can justify additional effort in the audit of internal control, as well as additional substantive work in the financial statement audit, regardless of the reliability of controls.

A **fraud risk assessment** is part of the risk assessment for the financial statement audit, and this risk assessment should be taken into account in the audit of internal controls. The auditor should evaluate whether the company's controls sufficiently address identified risks of material misstatement due to fraud. The auditor should also evaluate controls intended to address the risk of management override of other controls.

PCAOB Auditing Standard 5: Steps to a Top-Down Approach

The steps to be followed in a top-down approach include the following, according to PCAOB Auditing Standard 5. This guidance is directed to external, independent auditors. However, external auditors will be auditing management's assessment of the company's internal control over financial reporting, and internal auditors assist with that management assessment. Therefore, this guidance is useful for internal auditors as well.

- 1) The auditor should use a top-down approach to the audit of internal control over financial reporting to select the controls to test. A top-down approach begins at the financial statement level and with the auditor's understanding of the overall risks to internal control over financial reporting. The auditor then focuses on **entity-level controls** and works down to significant accounts and disclosures and their relevant assertions.

This approach directs the auditor's attention to accounts, disclosures, and assertions that present a reasonable possibility of material misstatement to the **financial statements and related disclosures**. The auditor then verifies his or her understanding of the risks in the company's processes and selects for testing those controls that sufficiently address the assessed risk of misstatement to each relevant assertion.

Note: The top-down approach describes the auditor's sequential thought process in identifying risks and the controls to test, not necessarily the order in which the auditor will perform the auditing procedures.

Entity-level controls are:

- Controls that are related to the **control environment**. The auditor should assess (1) whether management's philosophy and operating style promote effective control over financial reporting, (2) whether sound ethical values, particularly of top management, are developed and understood, and (3) whether the Board or audit committee understands and exercises their oversight responsibility over financial reporting and internal control.
 - Controls over **management override**, i.e., the ability of a manager to override an existing control on his or her own authority.
 - The company's **risk assessment process**.
 - **Centralized processing controls**, such as over information processing, including any shared service environments.
 - Controls to **monitor results of operations**.
 - Controls to **monitor other controls**, including activities of the internal audit function, the audit committee, and control self-assessment programs. These controls might be designed to identify breakdowns in lower-level controls.
 - Controls over the **period-end financial reporting process**, including procedures for entering transaction totals into the general ledger; procedures related to the selection and application of accounting policies; procedures used to initiate, authorize, record and process journal entries in the general ledger; procedures for recording recurring and nonrecurring adjustments to the financial statements; and procedures for preparing annual and quarterly financial statements and related disclosures.
 - Policies that address significant **business control and risk management practices**.
- 2) **Identify entity-level controls.** Entity-level controls, as defined above, are those controls that will make a difference in the auditor's conclusion about whether the company has effective internal control over financial reporting.
 - 3) **Identify significant accounts and disclosures and their relevant assertions.** "Relevant assertions" are financial statement assertions that have a reasonable possibility of containing a

misstatement that would cause the financial statements to be materially misstated. Financial statement assertions include the following:

- **Existence or occurrence** - whether assets/liabilities **exist** at a given date; and whether recorded transactions have **occurred** during a given period.
- **Completeness** - whether all transactions and accounts that should be presented in the financial statements are included.
- **Valuation or allocation** - whether the assets, liabilities, revenues, and expenses of an entity have been included in the financial statements at the appropriate amounts in conformity with GAAP.
- **Rights and obligations** - whether, at a given date, all assets **are** the rights of the entity and all liabilities **are** the obligations of the entity.
- **Presentation and disclosure** - whether financial statement components have been properly **classified, described, and disclosed**.

4) **Understand likely sources of misstatement.** The auditor must do the following:

- Understand the flow of transactions related to the relevant assertions.
- Identify the points in the process at which a material misstatement could arise. This must include consideration of a misstatement due to fraud.
- Identify the controls that management has implemented to address these potential misstatements.
- Identify the controls that management has implemented to either prevent or detect in a timely manner any unauthorized acquisition, use, or disposition of the company's assets that could result in a material misstatement of the financial statements.

5) **Select controls to test.** The auditor needs to **test** the controls that will make a difference in the auditor's conclusion about whether the company's controls are adequate to address the assessed risk of misstatement to each relevant assertion. **Controls should be selected for testing based on whether they sufficiently address the risk**, not on how the control is labeled. In other words, whether a control is considered an entity-level control, a transaction-level control, a control activity, a monitoring control, a preventive control or a detective control is not important. What is important is whether the control addresses the risk and addresses it sufficiently.

6) **Test design effectiveness and operating effectiveness of the controls.** To test the design effectiveness of the selected controls, the auditor makes inquiries of appropriate personnel, observes the company's operations and inspects documentation. The auditor does this to determine whether the controls satisfy the company's control objectives and can effectively prevent or detect errors or fraud that could result in material misstatements in the financial statements. To test the operating effectiveness of each control, the auditor determines whether it is operating as it was designed and whether the person performing the control possesses the necessary authority and competence to perform it effectively.

If the auditor finds things are not being done in accordance with a control procedure, the auditor should determine the effect of the deviation from procedure on his or her assessment of the risk associated with the control being tested and the evidence to be obtained, **as well as** on the operating effectiveness of the control.

The evidence necessary for the auditor to determine whether each selected control is effective depends on the risk associated with the control. An individual control does not necessarily have to operate without any deviation to be considered effective. However, it usually requires less evidence to support a conclusion that a control is **not** operating effectively than it does to support a conclusion that a control **is** operating effectively. In other words, for the amount of evidence required, the bar is

set higher for a determination that the control is operating effectively than it is for a determination that the control is not operating effectively.

- 7) **Evaluate identified deficiencies.** For each control deficiency that the auditor becomes aware of, the auditor must evaluate its severity. The purpose of this evaluation is to determine whether the deficiency, either alone or in combination with other deficiencies, represents a material weakness. The severity of a deficiency depends on (1) whether there is a **reasonable possibility** that the company's controls will fail to prevent or detect a misstatement of an account balance or disclosure; and (2) the **magnitude, or size**, of the potential misstatement resulting from the deficiency or deficiencies. Indicators of material weakness include
- **Identification of fraud**, whether or not material, on the part of senior management;
 - **Restatement of previously issued financial statements** in order to correct a material misstatement;
 - Identification by the auditor of a **material misstatement of financial statements in the current period**, if the circumstances of the misstatement indicate that it would not have been detected by the company's internal control over financial reporting; and
 - **Ineffective oversight by the company's audit committee** over the company's external financial reporting and over its internal control over financial reporting.

SEC Release 33-8810

SEC Release 33-8810, the guidance for management in assessing its internal control over financial reporting, also contains information about how a **risk-based, top-down approach** to assessing internal control over financial reporting (abbreviated as "ICFR" in the release) should be performed. Since internal auditors assist management in this assessment, this is information for them as well. The guidance includes:

- 1) **Identify financial reporting risks and controls.** Management should evaluate whether it has implemented controls that will achieve the objective of ICFR. That objective is **to provide reasonable assurance regarding the reliability of financial reporting**.

The evaluation begins with the identification and assessment of the risks to reliable financial reporting, including changes in those risks. "Reliable financial reporting" is considered to be **materially accurate financial statements**. Management then evaluates whether it has controls placed in operation that are designed to adequately address those risks.

Management should consider the company's **entity-level controls**^w in both its assessment of risks and in identifying which controls adequately address the risks.

- a. **Identify financial reporting risks.** Management should identify those risks of misstatement that could, individually or in combination with others, result in a material misstatement of the financial statements. Usually, this identification of financial reporting risks should begin with evaluating how the requirements of GAAP apply to the company's business, operations and transactions.

Internal and external risk factors that impact the business, including any changes in those risks, may give rise to a risk of misstatement. Risks of misstatement may also arise from sources such as the initiation, authorization, processing and recording of transactions and other adjustments that are reflected in financial reporting elements.

^w Recall that **entity-level controls** include: (1) controls related to the control environment; (2) controls over management override; (3) the company's risk-assessment process; (4) centralized processing controls; (5) controls to monitor results of operations; (6) controls to monitor other controls; (7) controls over the period-end financial reporting process; and (8) policies that address significant business control and risk management practices.

Management may find it useful to consider “what could go wrong” within a financial reporting element. This can help to identify the sources and the potential likelihood of misstatements and then to identify which of those sources could result in a material misstatement of the financial statements.

Management’s evaluation of the risk of misstatement should include consideration of how vulnerable the company is to fraudulent activity and whether the exposure could result in a material misstatement of the financial statements.

Fraudulent activity includes (1) fraudulent financial reporting, (2) misappropriation of assets and (3) corruption.

- b. **Identify controls that adequately address the identified financial reporting risks.** Management should evaluate whether it has placed in operation controls that adequately address the company’s financial reporting risks. The determination of whether an individual control, or a combination of controls, adequately addresses a particular financial reporting risk involves **judgments** about whether the controls, if operating properly, can effectively prevent or detect misstatements that could result in material misstatements in the financial statements. Preventive controls, detective controls, or a combination of both may adequately address financial reporting risks.

If management determines that a **deficiency** in ICFR exists, the deficiency must be evaluated to determine whether a **material weakness** exists.

- c. **Consideration of entity-level controls.** Management must evaluate whether it has the entity-level controls in place that are necessary for an effective system of internal control. This would include considering whether the following are adequate to achieve an effective system of internal control: controls related to the control environment; controls over management override; the entity-level risk assessment process and monitoring activities; and the policies that address significant business control and risk management practices.

Entity-level controls may be designed to operate at the process, application, transaction or account level. They need to operate at a level of precision that would adequately prevent or detect on a timely basis misstatements in one or more financial reporting elements that could result in a material misstatement of the financial statements.

- d. **Role of Information Technology general and application controls.**^x Controls that address financial reporting risks may be automated, dependent upon IT functionality, or they may be a combination of both manual and automated procedures. When controls are automated, evaluation of them needs to consider the design and operation of the automated or IT-dependent **application controls** as well as the **general IT controls** over the applications that provide the IT functionality.

IT general controls alone ordinarily do not adequately address financial reporting risks. However, the proper operation of automated controls or IT functionality often depends upon effective IT general controls.

The identification of risks and controls within IT should be an integral part of management’s top-down, risk-based approach to identifying risks and controls and in determining what evidence is needed to support its assessment of its ICFR.

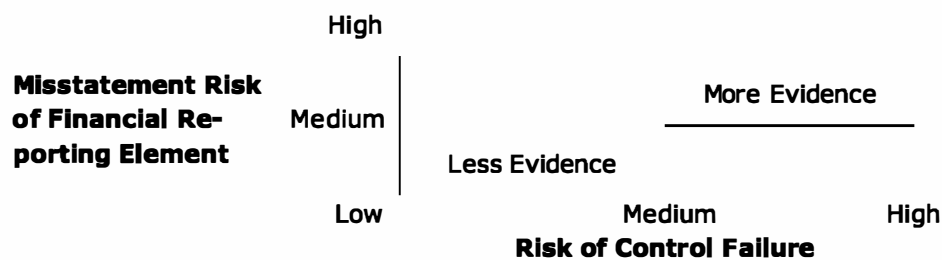
- e. **Evidential matter to support the assessment.** The design of the controls management has placed in operation to adequately address the financial reporting risks should be documented. This is an integral part of maintaining reasonable support for management’s assessment.

^x See the next section “Systems Controls and Security Measures” for an indepth discussion of general controls and application controls.

- 2) **Evaluate evidence of the operating effectiveness of ICFR.** Evaluation of the operating effectiveness of a control considers whether the control is operating as designed and whether the person performing the control possesses the necessary authority and competence to perform the control effectively. Management should focus its evaluation of the operation of controls on areas that pose the highest ICFR risk. Management's assessment of ICFR risk also should consider the impact of entity-level controls, such as the relative strengths and weaknesses of the control environment, which may influence management's judgments about the risks of failure for particular controls.

Evidence about the effective operation of controls can come from direct testing of controls and also from on-going monitoring activities. In determining whether the evidence obtained is sufficient to provide a reasonable basis for its evaluation of the operation of ICFR, management should consider not only the quantity of evidence (for example, sample size), but also the qualitative characteristics of the evidence. The qualitative characteristics of the evidence include the nature of the evaluation procedures performed, the period of time to which the evidence relates, the objectivity of those evaluating the controls, and, in the case of on-going monitoring activities, how much validation has been done through direct testing of underlying controls.

- a. **Determine the evidence needed to support the assessment.** This evaluation should consider the characteristics of the financial reporting elements to which the controls relate and the characteristics of the controls themselves. The risk of misstatement and the risk of control failure should be evaluated on a scale like the following, which considers both the misstatement risk of the financial reporting element and the risk of a control failure, to determine whether more evidence or less evidence will be required to support the assessment:



Management's consideration of the likelihood that a control might fail to operate effectively includes, among other things:

- The type of control (manual or automated) and the frequency with which it operates;
- The complexity of the control;
- The risk of management override;
- The judgment required to operate the control;
- The competence of the personnel who perform the control or monitor its performance;
- Whether there have been changes in key personnel who either perform the control or monitor its performance;
- The nature and materiality of misstatements that the control is intended to prevent or detect;
- The degree to which the control relies on the effectiveness of other controls (for example, IT general controls); and
- The evidence of the operation of the control from prior year(s).

- b. **Implement procedures to evaluate evidence of the operation of ICFR.** Management should use its assessment of ICFR risk to determine the evaluation methods and procedures that will be needed to obtain sufficient evidence. The evaluation methods and procedures may be integrated with the daily responsibilities of its employees or implemented specifically for purposes of the ICFR evaluation. The evidence management evaluates comes from direct tests of controls, on-going monitoring, or a combination of both.

Direct tests of controls are tests ordinarily performed on a periodic basis by objective individuals. Direct tests provide evidence as of a point in time and may provide information about the reliability of on-going monitoring activities. **On-going monitoring** includes management's normal, recurring activities that provide information about the operation of controls.

When ICFR risk is assessed as high, the evidence management obtains would ordinarily consist of direct testing performed by individuals who have a higher than usual degree of objectivity relative to the controls being tested. When ICFR risk is assessed as low, management may conclude that evidence from on-going monitoring is sufficient and that no direct testing is required.

- c. **Evidential matter to support the assessment.** Management's assessment must be supported by evidence that provides reasonable support for its assessment. The nature of the evidential matter may vary based on the assessed level of ICFR risk of the underlying controls and other circumstances, as stated above.

Reasonable support for an assessment would include the basis for management's assessment, including documentation of the methods and procedures it used to gather and evaluate the evidence. The evidential matter constituting reasonable support for management's assessment would also ordinarily include documentation of how management formed its conclusion about the effectiveness of the company's entity-level and other pervasive elements of ICFR that its applicable framework describes as necessary for an effective system of internal control.

- 3) **Multiple location considerations.** Management's consideration of financial reporting risks generally should include all of its locations or business units. Management may determine that financial reporting risks are adequately addressed by controls which operate centrally. In that case, the evaluation approach is similar to that of a business with a single location or business unit. However, if the controls necessary to address financial reporting risks operate at more than one location or business unit, management should generally evaluate evidence of the operation of the controls at each individual locations or business units.
- 4) **Evaluate control deficiencies.** In order to determine whether a control deficiency, or combination of control deficiencies, is a material weakness, management should evaluate the severity of each control deficiency that comes to its attention.

Top-Down Approach Versus Bottom-Up Approach

In contrast to the top-down, risk-based approach, an auditor who approaches the audit of internal controls from the bottom up would focus first on performing detailed tests of controls at the process, transaction, and application levels. It is important for the auditor to use a top-down approach, because when the auditor uses a bottom-up process, he or she often spends more time and effort than is necessary to complete the audit. Furthermore, when an auditor takes a bottom-up approach, the auditor may spend relatively little time testing and evaluating entity-level controls but may rely almost exclusively on detailed tests of controls over individual processes, transactions and applications. Spending more effort than is necessary in lower-risk areas can diminish the effectiveness of the audit because it may prevent a higher-risk area from receiving the audit attention that it should receive.

A top-down approach ensures that the controls that address the assessed risk of misstatement to each relevant assertion are tested. If a bottom-up approach is used, those controls that address the risk of a material misstatement may not be tested.

What Internal Control Can and Cannot Do

As a conclusion to internal controls, it is important that we remember what can be expected of internal control and what internal control cannot do.

Internal controls **can** help:

- An organization get to where it wants to go, avoiding pitfalls and surprises along the way;
- An organization achieve its performance and profitability goals and prevent loss of resources;
- Ensure reliable financial reporting; and
- Ensure that the organization complies with laws and regulations.

However, internal controls **cannot provide a guarantee** for the company. The COSO report warns against promoting internal control as a guarantee that the entity will achieve its financial reporting, operational, and compliance objectives. Internal control has limitations including simple human error or faulty judgments; and controls can be circumvented through collusion and well-planned fraud. Connected to this, **internal control can provide only reasonable assurance to management and the board of directors regarding achievement of the entity's objectives.**

Furthermore, internal controls must be evaluated in terms of the **cost-benefit relationship**. The cost of the operations of the controls should be less than the benefit that is derived from them. This will lead to some controls not being implemented and a company accepting some amount of risk simply because the cost of the necessary controls (in time, money, or both) are too great.

Internal Auditing

Having looked at Internal Control, we will now turn our attention to Internal Auditing.

Definition of Internal Auditing

Internal auditing has undergone major changes in the past few decades and has come to include areas of expertise and use outside of strictly financial and accounting matters. This growth of the role and expectations of internal auditors has led to the development of internal auditing as a profession. The Institute of Internal Auditors, the professional organization of internal auditors, has defined the fundamental purpose, nature, and scope of internal auditing as:

“an independent, objective assurance and consulting activity designed to add value and improve an organization’s operations. It helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control and governance processes.”

An effective internal audit function provides to management and the audit committee a means of **monitoring** the reliability of financial reporting and the organization’s control over operations. The monitoring of control over operations includes the effectiveness and efficiency of operations and the organization’s compliance with applicable laws and regulations.

The functional areas of internal auditing are similar to the functional areas of internal control. Recall that internal control is a process that is designed to provide reasonable assurance that the company’s objectives in **effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations** will be achieved. Internal auditing services contribute to the achievement of these internal control objectives by **providing monitoring services for the controls over them**. And achieving the organization’s internal control objectives contributes to the organization’s achieving its strategic objectives.

Therefore, auditing services fall into three fundamental categories:

- 1) **Operational** – reviewing the various functions within the organization in order to appraise the efficiency and economy of operations and the effectiveness with which the functions achieve their objectives.
- 2) **Financial** – reviewing the economic activity of the organization as it is measured and reported by accounting methods.
- 3) **Compliance** – reviewing both financial and operating controls and transactions to determine whether they conform to laws, standards, regulations and procedures.

Based on the recommendations of the IIA, within these three functional areas, the scope of internal auditing work encompasses:

“a systematic, disciplined approach to evaluating and improving the **adequacy and effectiveness of risk management, control and governance** process and the quality of performance in carrying out assigned responsibilities. The purpose of evaluating the adequacy of the organization’s existing risk management, control, and governance process is to provide **reasonable assurance** that these processes are functioning as intended and will enable the organization’s objectives and goals to be met, and to provide recommendations for improving the organization’s operations, in terms of both **efficient and effective** performance. Senior management and the board might also provide general direction as to the scope of work and the activities to be audited.”

The **adequacy** of risk management, control, and governance processes is present if management has planned and designed for these items in a manner that provides reasonable assurance that the organization’s objectives and goals will be achieved **efficiently and economically**.

Responsibilities of the Internal Auditing Function

In addition to the internal development that has taken place within the profession, internal auditing has grown because of the general expectation for public companies to have an internal audit function and an audit committee composed of nonmanagement directors.

The internal audit function should encompass every part of the organization's operations, and to this end it should have unlimited access to the company's documents, records or properties. While what the internal audit function does is great in scope, there is a very specific limit to their responsibilities.

The responsibility of the internal auditor is to **review and appraise policies, procedures, plans and records for the purpose of informing and advising management.**

However, internal auditors **do not have any authority or responsibility over operating activities.** If they had this responsibility, it would impair any independence and objectivity the internal auditors may have in working in these areas because they would in essence be auditing themselves.

The responsibility of internal audit ends with the making of recommendations. Auditors should have no authority over or responsibility for the activities they audit or the implementation of their recommendations. It is the responsibility of the board or management to implement the recommendations brought to them by the internal auditors.

The practice of internal auditing is governed by the International Standards for the Professional Practice of Internal Auditing (hereinafter called Internal Auditing Standards) promulgated by the Institute of Internal Auditors. Internal auditors can also draw guidance from auditing standards for independent, external auditors. In the U.S., these include the AICPA's Auditing Standards and the PCAOB's Auditing Standards.

Internal Auditors and the Internal Control System

As we saw in the section on Internal Control, it is the company's management – including the board of directors – who is responsible for the organization's internal control. In order to assist management in the fulfillment of this responsibility, internal auditors are utilized to **monitor the performance** of the organization's internal control systems.

Thus, internal auditing has developed to **assist management in carrying out its monitoring responsibilities in an effective and efficient manner.** The objective of internal audit is to **promote effective monitoring of control activities at a reasonable cost.**

Internal auditors' responsibilities with respect to the internal control system include:

- Evaluation of the adequacy and effectiveness of the control system in a systematic and thorough manner.
- Testing individuals' compliance with controls to determine whether policies and procedures established by management are being followed, i.e., the quality of performance in carrying out assigned responsibilities.
- Examination and evaluation of the reliability and integrity of financial and operating information and the means used to identify, measure, classify and report it.
- Reviewing systems that impact operations and reports to determine whether the organization is in compliance with policies, plans, procedures, and regulations.
- Examination and evaluation of the effective and efficient use of an entity's resources.
- Reviewing the means used to safeguard assets and verifying the existence of those assets as appropriate.
- Furnishing analyses, appraisals, recommendations, counsel and information concerning activities reviewed to the management of the organization in order to assist them in the effective discharge of their responsibilities.

The Organizational Status of the Internal Audit Function

For the internal audit function to accomplish all of these varied responsibilities, it must have the necessary status within the organization. This means it must have adequate authority and freedom to carry out the activities that need to be accomplished.

The internal audit function should report to the board of directors through the audit committee.

This reporting function should include support from the board. The internal auditors need to be supported by both the audit committee and the board in order to make sure that those who are audited cooperate with the internal auditors. The support of the board and audit committee will demonstrate that the work being done by the internal auditors is viewed as important for the organization.

Along with the correct level of organizational status, the internal audit department must also have **organizational independence**. This means that the internal audit function should not have any direct relationships with the various departments it will be auditing. Reporting directly to the board of directors achieves this organizational independence.

Note: It is important that internal auditors remain detached from the items that they are auditing or reviewing so that they will be able to carry out their duties to management. Therefore, after a person joins internal audit, that person should not audit the area he came from for a reasonable amount of time. The IIA recommends this reasonable time to be a minimum of one year.

Question 170: Which of the following statements represents the most important benefit that the internal audit department provides to management?

- a) Assurance that the organization is in compliance with legal requirements.
- b) Assurance that fraudulent activities will be detected quickly.
- c) Assurance that there is reasonable control over day-to-day operations.
- d) Assurance that external financial statements are correct.

(CMA Adapted)

Question 171: Management has requested the internal auditing department to perform an operational audit of the telephone marketing operations of a major division and recommend procedures and policies for improving management control over the operation. The auditor should:

- a) Accept the engagement, but indicate to management that recommending controls would impair audit independence so management knows that future audits of the area would be impaired.
- b) Accept the audit engagement because independence would not be impaired.
- c) Not accept the engagement because audit departments are presumed to have expertise on accounting controls, not marketing controls.
- d) Not accept the engagement because recommending controls would impair future objectivity of the department regarding this auditee.

(CIA Adapted)

The Difference Between Internal Auditors and External Auditors

The **external** auditors, or **independent** auditors, perform the **financial statement audit**. Their responsibility is to issue an opinion on the accuracy and fairness of management's assertions regarding the financial statements. The external auditor focuses on the financial accounting system and only those activities that have a direct, material effect upon the financial statements.

The external auditors are also responsible for performing an audit of management's assessment of the effectiveness of internal control over financial reporting, and this audit is to be integrated with the audit of the financial statements.

A CPA firm that is nominated by the board of directors does the external auditing. The external auditors are not employees of the company and they do not have any financial interest in the company. The external auditor's objective is to (1) express an opinion on whether the financial statements present fairly, in all material respects, the financial position, results of operations and cash flows of the company, in conformity with generally accepted accounting principles; and (2) express an opinion on whether the company's management has maintained effective internal control over financial reporting.

For the opinion on the financial statements, the auditor conducts an independent examination of the accounting data prepared and presented by management and expresses an opinion on them. The auditor's report should include an indication of the character of the auditor's examination and the degree of responsibility the auditor is taking. The auditor's responsibility is a legal one because investors and other users of the financial statements rely on the auditor's report, so the auditor's report must be reliable. This legal responsibility was increased with the Sarbanes-Oxley Act.

The second report, required by the Sarbanes-Oxley Act, is the auditor's opinion on whether the company's management has maintained effective internal control over financial reporting. The company's annual report filed with the SEC (incorporated into the annual report to shareholders) must be accompanied by a statement of management that management is responsible for creating and maintaining adequate internal controls. Management's statement must set forth management's assessment of the effectiveness of these controls. The company's independent auditor must report on and attest to management's assessment of the effectiveness of the internal controls. This is considered to be the core responsibility of the auditor and an integral part of the audit report.

The auditor's opinion states that management is responsible for maintaining effective internal control over financial reporting and for assessing the effectiveness of its internal control over financial reporting; and that the auditor's responsibility is to express an opinion on the company's internal control over financial reporting based upon its audit. Guidance for the independent auditor in performing this audit of internal control over financial reporting is contained in the PCAOB's Auditing Standard No. 5.

The responsibility of **internal auditors**, on the other hand, is to compare "what is" in the company with "what should be" in the company and report to management their findings. In addition to their findings, the internal auditor develops and communicates suggestions and recommendations for improvement.

Internal auditors are employees of the organization they audit. Therefore, they are not referred to as "independent auditors," because they are not independent. Despite this, internal auditors must maintain their objectivity, or **organizational independence**. **Objectivity** is essentially the same thing as independence in that it means that the internal auditor will act without bias, but the term "independent" is reserved for the external auditor only.

Because of this necessity to maintain objectivity, internal audit should **not** report administratively to management. **Internal audit should be primarily responsible to the board of directors through the audit committee.** An audit committee entirely composed of independent, outside directors enhances the internal auditors' independence from management. The audit committee should be responsible for supervising the hiring, promotion and compensation of the chief audit executive (the head of the audit department).

Despite the fact that internal auditors are distinct from external auditors and that it is the external auditors who will express an opinion on the financial statements, internal auditors do have a responsibility to assist the independent, external auditor in its audits of the organization's financial statements and of the organization's management's control over financial reporting. This assistance would take place only if the independent auditor chooses to use the internal auditors' work, after assessing their competence and objectivity as well as the amount of risk associated with the financial statement assertion or the control being tested.

Coordination of Work Between Internal and External Auditors

Costs of the external audit can be greatly reduced if the external auditor can use the work already done or work performed by internal auditors to assist during the external audits of the financial statements and of management's internal control over financial reporting.

However, as referred to above, external auditors must base their justification for reliance on work by internal auditors upon (1) the internal auditors' **competence** and (2) the internal auditors' **objectivity**. If internal auditors are competent, skilled in auditing techniques and have a broad perspective of controls, they can assist the external auditors with the audits of the organization. Competent internal auditors can eliminate the need for some of the work that might otherwise be done by the external auditors.

Note: It is important to remember that no matter how competent and objective the internal auditors are, when they are assisting the external auditor, **the external auditor will never allow them to assess risk or draw a conclusion**. The external auditor will try to use the work that the internal auditors do in areas that do not include great amounts of subjectivity. For example, existence of fixed assets is not something that requires estimates, but the valuation of fixed assets includes large estimates. Therefore, internal auditors can assist more in verifying the existence of fixed assets than they can assist in the valuation of those fixed assets.

Work done by internal auditors to test internal financial controls can be valuable to external auditors, subject to the following guidelines:

- 1) The internal auditors are not to direct the external audits of the organization's financial statements or management's control over financial reporting.
- 2) Before relying on the work of internal auditors, the external auditors must review and test the work performed by the internal auditors.
- 3) In the assessment of audit risk and in the performance of the audit, the internal auditor will not make any decisions or conclusions. This is to be done only by the external auditor.
- 4) The work of the internal and external auditors should be coordinated so as to reduce the amount of duplicate work that is done by both parties.
- 5) Because the internal auditors are a related party to the company, the external auditor will supervise any work done by the internal auditor as part of the external audit.

Question 172: When working with the external auditors in the audit of the financial statements, the internal auditor should:

- a) Set materiality for their work lower than the materiality set by the external auditor.
- b) Set materiality for their work higher than the materiality set by the external auditor.
- c) Be independent of the external auditor.
- d) Be supervised by the external auditor.

(CMA Adapted)

Types of Engagements

Internal auditors perform two basic types of services: **assurance services** and **consulting services**.

Assurance Services

Assurance services involve performing an objective examination of evidence for the purpose of providing an independent assessment on **governance, risk management, and control processes** for the organization. Examples may include **financial, performance, audit of financial controls, compliance, system security, and due diligence** engagements. They provide an assessment of the reliability and/or relevance of data and operations in specific areas.

Assurance services include:

Financial Audit

The purpose of an internal **financial audit** is to analyze the economic activity of an entity as measured and reported by accounting methods. It is **not** the same as the purpose of an independent, external audit of the financial statements. The purpose of the **Independent** audit is to evaluate the assertions made by management on the organization's financial statements and to issue an opinion on the fairness of the statements. Internal auditors may be able to assist with the independent audit. However, a financial audit performed by an **internal** auditor is not performed for the purpose of issuing an opinion on the fairness of the financial statements, although the internal auditors may perform many of the same activities.

A financial audit performed by the internal audit activity usually is done on one specific area of the organization. Areas where internal auditing evaluations may be used by the independent auditors are evaluations of cash controls, accounts receivable, accounts payable, and other financial activities.

Like the independent auditors, the internal auditors will be looking at the financial assertions with the goal of determining whether the assertions can be proved. To review, those assertions are:

- 1) **Existence or occurrence** – whether the item represents actual transactions and events, whether assets/liabilities actually exist at a given date and whether recorded transactions have occurred during a given period.
- 2) **Completeness** – whether all transactions and accounts that should be presented in the financial statements are included and no material financial information has been omitted.
- 3) **Rights and obligations** – whether, at a given date, all assets (rights) actually are the rights of the entity and whether all liabilities (obligations) actually are the obligations of the entity; and whether all material rights and obligations with respect to assets, liabilities and equity accounts have been disclosed.
- 4) **Valuation or allocation** – whether the assets, liabilities, revenues and expenses of the entity have been included in the financial statements at the appropriate amounts in conformity with GAAP, i.e., the numbers in the financial statements are materially correct.
- 5) **Presentation and disclosure** – whether the financial statement components have been properly classified, described, and disclosed. In other words, whether the format, organization and classification of accounts on the financial statements and disclosures in the accounts, footnotes and accounting policies conform to generally accepted accounting principles.

Performance (or Operational) Audit

The purpose of a **performance or operational audit** is examining and evaluating systems of internal control, overall company operations and the quality of performance in carrying out assigned responsibilities. In order to assess these items, a company **must have a standard level** of behavior or output, or something that is to be achieved. The internal auditors will then compare the results of the operations with these standards.

The focus of a performance or operational audit is on the three Es – **efficiency, effectiveness and economy**. The main techniques for the auditor in a performance audit are financial analysis, the observation of departmental activities and questionnaire interviews of employees.

In addition, as part of an operational audit, the internal auditor will **make recommendations** about how to improve the process or operation.

The scope of the performance or operational audit exceeds that of a financial audit. Internal auditors will evaluate the adequacy and effectiveness of the controls that are in place in relation to operating information, as well as financial records and information, which is the focus of the financial audit. The internal auditors will also look at areas that do not affect the financial statements themselves. This will include controls related to policies, procedures and decision-making.

In auditing controls, the internal auditor evaluates the adequacy and effectiveness of existing controls in responding to risks within the organization's governance, operations, and information systems regarding the

- Reliability and integrity of financial and operational information;
- Effectiveness and efficiency of operations;
- Safeguarding of assets; and
- Compliance with laws, regulations, and contracts (Internal Auditing Standard No. 2130.A1).

There will be overlap between an audit of controls as part of a performance audit and an audit of financial controls, discussed next.

Audit of Financial Controls

An **audit of financial controls** involves examining two aspects of financial internal controls: (1) controls over financial resources; and (2) controls over the accounting for financial resources.

Internal auditors are concerned with the accountability of the assets. At all times, someone should be responsible for them and there should be periodic checks of the existence and condition of those assets. Protection is needed against risks such as fire, flood and other natural disasters.

External, independent auditors are concerned with controls over financial reporting, since they must integrate an audit of the company's internal control over financial reporting with their audit of the financial statements. The independent auditors may use the work performed by, or receive direct assistance from, the internal auditors in this area. Before using the work of the internal auditors, the independent auditor must assess the competence and objectivity of the internal auditors who would be used for that as well as the amount of risk associated with the control being tested. Internal auditors may be used, at the independent auditor's discretion, to test controls that carry lower risk. As the risk associated with a control increases, however, the need for the independent auditor to perform his or her own work on the control increases (PCAOB Auditing Standard No. 5, paragraphs 16-19).

However, if internal auditors are doing their own audit of financial controls of an area, they will be more involved in auditing internal controls than they might be if they are assisting the independent auditor; and the work they do may be ultimately used by the independent auditor in the annual audit.

Because of its importance, auditing of financial controls will be discussed in more detail later.

Compliance Audit

A **compliance audit** is performed in order to determine to what degree an organization is operating in an orderly way, effectively and visibly conforming to certain specific requirements of its policies, procedures, standards, or laws and governmental regulations. Compliance auditing is more objective than other internal auditing applications. To perform a compliance audit, the auditor must know exactly what policies, procedures, standards, laws, etc., are required.

In a compliance audit, the internal auditor is not interested only in the compliance or lack of compliance, but in case of noncompliance, he or she will also determine the **cause** of the noncompliance, the **cost** of the noncompliance and **what needs to be done** in order to be in compliance.

The causes of noncompliance may be faulty procedures, changes in the conditions related to the regulation, or perhaps simply mistakes and lack of review or supervision.

System Security Audit

A **system security audit** involves auditing the controls in place for information systems. Information systems control is covered in detail in the next section, "Systems Controls and Security Measures."

Due Diligence Engagement

A **due diligence engagement** is an engagement to confirm company records, both financial and those of ownership of property, utilized especially when a unit is being acquired, merged or sold.

Consulting Services

Consulting services are advisory and other related client service activities. Usually they are performed at the request of the client, and their nature and scope are agreed upon with the client. They are intended to **add value and improve** an organization's governance, risk management, and control processes without the internal auditor assuming management responsibility. Examples include counsel, advice, facilitation, and training.

Some examples of consulting services are:

- **Quality audit** – evaluating the quality of the product or service being provided.
- **Special Engagements** – An example of a special engagement is a **fraud audit**. Fraud audits are performed for the purpose of discovering the presence, scope and means of either misappropriation of assets or fraudulent reporting. The objective of a fraud audit is to uncover what has been intentionally covered up, and thus a fraud audit is more detailed than other types of audits.

If wrongdoing is suspected as a result of a routine internal audit and if management decides to perform a fraud audit in response, several departments, such as a fraud investigation or security department, may be involved in the audit along with the internal auditor. The internal auditor will work with them as part of a team. Additionally, external auditors or other parties outside the organization may be called in to assist, and the internal auditor will work cooperatively with them, as well.

Per Internal Auditing Standard No. 2120,

- During consulting engagements, internal auditors must address risk consistent with the engagement's objectives and be alert to the existence of other significant risks.
- Internal auditors must incorporate knowledge of risks gained from consulting engagements into their evaluation of the organization's risk management processes.
- When assisting management in establishing or improving risk management processes, internal auditors must refrain from assuming any management responsibility by actually managing risks.

The Auditing Process

In describing the auditing process, we will not look at each of the different types of engagements separately but will rather look at the planning and performance of an audit in a more general sense. However, we will look at fraud in more detail later.

Determining Which Engagements to Conduct

The chief audit executive makes the decisions regarding which engagements will be performed, and there are many factors that the chief audit executive will consider in making this decision. Many chief audit executives find it useful to first update the internal audit activity's **audit universe**. The audit universe is a list of all the possible audits that the internal audit activity is able to perform. To understand what the audit universe is, the chief audit executive should obtain input from senior management and the board. However, if the internal audit activity has been properly established and is appropriately independent and objective, the chief audit executive should be able to make these decisions with only limited involvement and interference from senior management or board.

Internal Auditing Standard No. 2010 says the following: "The chief audit executive must establish risk-based plans to determine the priorities of the internal audit activity, consistent with the organization's goals." One of the most important elements when prioritizing engagements is the consideration of risk. For this purpose, risk is defined as the likelihood that the goals and objectives of the organization will not be achieved.

In considering risk, the chief audit executive takes into account the organization's risk management framework, including using the risk appetite levels set by management for the different activities or parts of the organization. If a framework does not exist, the chief audit executive should use his or her own judgment of risks, after consultation with senior management and the board.

It is largely through this consideration of risk that the chief audit executive is able to prioritize the engagements that need to be performed. This is not to say that risk is the only criteria used, because there are other factors that will be considered as well, including:

- The length of time since the last engagement was performed in this area;
- Requests from senior management, the audit committee or other governing bodies;
- An engagement's relation to the external audits of financial statements and management control over financial reporting;
- Changing circumstances in the business, operations, programs, systems or controls;
- Changes in the risk environment or control procedures in a given department;
- The potential benefit that could be achieved from the engagement; and
- Changes in the skills of the available staff, because new skills may enable the internal audit activity to conduct different types of engagements. For instance, a new employee may bring new skills, or training may give an existing staff member new skills.

However, of these, **risk assessment** is generally the most important, and one of its issues is the fact that there are both quantitative (numerical) assessments as well as qualitative (characteristics) assessments. Quantitative assessments would include the dollar value of the assets at risk or the potential loss, while qualitative assessments include things such as risk in the area of fraudulent behavior or the importance of the section to the operations of the business as a whole.

One way to measure the extent of risk in different areas is to multiply the dollar amount that is at risk of loss by the percentage chance of the loss occurring. In this way, the chief audit executive is able to address the fact that, for instance, while petty cash is at great risk because it is cash that is, in essence, available to everyone in the organization, there is not much cash at risk at any one time because there is never much cash in petty cash. When combining these factors, petty cash is probably a lower priority when compared to an area where there is a lower risk of loss, but the potential amount of the loss is much greater.

The above discussion has focused on a monetary measurement. However, there are also risks that are not related to the assets of the company or to a specific monetary amount that also need to be assessed. For example, control procedures (or, more accurately, lack of control procedures) may also be an area of risk that would need investigation.

Planning the Audit

According to Internal Auditing Standard 2201, the internal auditor considers the following in planning the engagement:

- The objectives of the activity being reviewed and the means by which the activity controls its performance;
- The significant risks to the activity, its objectives, resources, and operations and the means by which the potential impact of risk is kept to an acceptable level;
- The adequacy and effectiveness of the activity's risk management and control processes compared to a relevant control framework or model; and
- The opportunities for making significant improvements to the activity's risk management and control processes.

Establishing Objectives

In **establishing the objectives** for the audit, Internal Auditing Standard 2210 states that:

- Internal auditors must conduct a preliminary assessment of the risks relevant to the activity under review. Engagement objectives must reflect the results of this assessment.
- Internal auditors must consider the probability of significant errors, fraud, noncompliance, and other exposures when developing the engagement objectives.
- Adequate criteria are needed to evaluate controls. Internal auditors must ascertain the extent to which management has established adequate criteria to determine whether objectives and goals have been accomplished. If adequate, internal auditors must use such criteria in their evaluation. If inadequate, internal auditors must work with management to develop appropriate evaluation criteria.
- Consulting engagement objectives must address governance, risk management, and control processes to the extent agreed upon with the client.

For example, if an internal auditor is auditing a receipts processing system, financial audit objectives would include:

- 1) Ensuring the correctness of the document that is passed to the accounts receivable accounting system;
- 2) Making sure that the negotiability of checks is limited by endorsing them immediately;
- 3) Determining whether the checks are protected from loss or misuse;
- 4) Determining whether deposits in the bank are made on a timely basis in order to obtain maximum use of the cash flow or, if applicable, interest;
- 5) Making sure that information posted to customer accounts will result in accurate credit records for aging of receivables and for customers' credit histories;
- 6) Establishing accountability for actions associated with handling checks in order to avoid any false accusations in the event of loss or fraud;
- 7) Determining what methods there are for handling and approval of exception items.

Assessing Audit Risk

Audit risk is a risk consideration the auditor must make in planning the audit. In a financial audit, **audit risk** exists at two levels: the financial statement level and the account balance or class of transactions level.

- At the financial statement level, audit risk is the risk that the auditor may fail to modify his or her opinion on financial statements that are materially misstated. This type of audit risk is faced by the external, independent auditor who is auditing a client's financial statements.
- At the account balance or class of transactions level, the auditor must consider financial statement assertions. These are the management's representations that are included in an account balance, in a class of transactions, or in disclosures. As we have seen, these management assertions are: **existence or occurrence, completeness, rights and obligations, valuation or allocation, and presentation and disclosure**. Audit risk at the account balance or class of transactions level consists of (1) the risk that the balance or class and related assertions contain misstatements that could result in material misstatements to the financial statements (inherent and control risk); and (2) the risk that the auditor will not detect any such misstatements that may exist (detection risk). This is the type of audit risk faced by the internal auditor. Inherent risk, control risk and detection risk are discussed in more detail below.

For example, if accounts receivable for a division at a certain date is \$150,000, the management assertions are:

- All of the receivables included in the balance of \$150,000 existed at that date (existence).
- All balances of customer accounts that are receivable are included in that accounts receivable balance (completeness).
- The receivables included in that balance represent claims that the division has on customers or others for goods or services provided (rights).
- The accounts receivable are properly valued (valuation or allocation).
- All receivables are properly disclosed (presentation and disclosure).

The risk of a material misstatement is the calculated result of the multiplication of three risk factors. These three risks are:

- **Inherent risk** – this is the risk that is natural in an element of the financial statements or the function being audited, assuming that there are no controls. It is the susceptibility to a material misstatement that exists "just because." An example of an inherent risk is the calculation of pension liabilities, which by nature are extremely complex.
- **Control risk** – this is the risk that an internal control will **not** prevent or detect a material misstatement in a timely manner. As we saw in the section on Internal Control, internal control is not a guarantee that an organization will achieve its financial reporting, operational and compliance objectives. No matter how well designed and operated it is, internal control can provide only reasonable assurance to management and the board of directors that the organization's objectives will be achieved. Major risks are that controls may fail because of human error, or they can be circumvented by collusion, or management may override internal control procedures.
- **Detection risk** – for an internal auditor, this is the risk that the auditor through audit testing will not detect a material misstatement in an account balance or class of transactions that could result in a material misstatement to the financial statements.

Audit risk, therefore, is calculated as follows:

$$AR = IR \times CR \times DR$$

Although the auditor **assesses** (determines the level of) inherent risk and control risk, these risks are not **influenced** by the auditor. This means that the auditor is not able to do anything to increase or decrease either of these risks. **Detection risk is the only risk that the auditor can influence.** Since the formula for calculating audit risk is a mathematical function, the auditor first determines the acceptable level of audit risk. Then, after assessing inherent risk and control risk, the auditor will be able to determine the level of detection risk needed to reach the acceptable audit risk level. That, in turn, will determine the audit procedures to follow for attaining the necessary level of detection risk in order to then attain the acceptable level of audit risk.

Since inherent risk is a basic or natural risk, the assessment of control risk is the critical step in the determination of the necessary level of detection risk, and therefore the determination of the nature, extent and timing of the audit procedures.

The **lower the control risk** (this means that there is a very low chance of an error coming out of the system), **the higher the detection risk can be** while still maintaining an acceptable level of audit risk. The opposite is also true in that a higher control risk means that we will need a lower detection risk in order to maintain the necessary level of audit risk.

Note: Control risk can be assessed in either a **quantitative manner** (1% – 100%) or a **qualitative manner** (minimum – maximum).

The auditor will assess control risk at the maximum if he/she feels that the internal controls for a particular assertion do not adequately address that assertion, if the controls are unlikely to be effective, or if evaluating the effectiveness of the controls would be ineffective. In this case, where control risk is assessed at the maximum level, the auditor simply needs to document his understanding of internal controls.

No matter which manner (quantitative or qualitative) is used, if the control risk is assessed **below the maximum level**, the auditor must document the tests performed in order to **confirm that the controls are, in fact, working and operating as planned.**

Note: This assessment of risk is different from the assessment that is made by the external auditors. The risk assessment made by the internal auditors may help or guide the external auditors, but the external auditors will make their own risk assessments.

Assessing Inherent Risk

The detailed objectives of the audit are the basis for assessing the inherent risk in an internal audit. Inherent risks as well as control risks are the risks that would prevent the unit from achieving its objectives.

Continuing the example from above of the receipts processing system and looking at objective no. 3, **"Determining whether the checks are protected from loss or misuse,"** the list of **inherent risks** that could prevent attainment of that objective that would be prepared by the internal auditor would include:

- 1) Checks can be exposed to loss between the post office and the company's incoming mailroom.
- 2) Envelopes containing checks are vulnerable while they are being sorted in the mailroom before being delivered to the receipts processing unit.
- 3) After receipt in the processing area, the checks are exposed to loss there until the bank deposit has been prepared.
- 4) Exception items can be misplaced, lost or mishandled during processing, because they require special handling and approval.
- 5) The bank deposit can be lost or stolen or stolen during transit from the processing center to the bank.
- 6) If the bank deposit is being delivered by an employee, that employee could be robbed and/or injured during the trip to the bank with the deposit.

A list of risks like the above would be prepared separately for each individual objective. The list is developed by the auditor by observing the activity and by using ingenuity, imagination, and an analytical approach. Audit risk and materiality are used to determine the nature, timing and extent of audit procedures to be completed, as well as the evaluation of the results of those procedures. **The internal auditor needs to think about what could go wrong and thereby stand in the way of achieving each objective.**

Assessing Control Risk

Once the inherent risks have been identified, the internal auditor assesses the controls that are in place to determine whether the controls are adequate and appropriate. An understanding of the control structure of the entity to be audited is basic to planning the audit and will be discussed in detail below.

If any risks are not adequately covered by controls, part of the auditor's responsibilities in the audit report will be to make recommendations about how to remedy the weaknesses identified. The auditor needs to look for the **optimum control structure**. "Optimum" does not mean perfect. The **optimum control structure** is the best control structure under the circumstances in light of the cost-benefit ratio.

Assessing Detection Risk

Detection risk can occur because an auditor decides not to examine all of the balances or transactions or processes or because of other uncertainties. The other uncertainties may include the auditor's selection of inappropriate audit procedures, misapplication of an audit procedure, or misinterpretation of the results of an audit procedure. If audit planning is done properly and the audit is properly supervised, these other uncertainties should be reduced to an acceptable level.

Risk Assessment Summary

The assessment of audit risk begins with inherent risks associated with the company and its management style. These inherent risks are countered by controls, and control risk is the risk that an internal control will **not** prevent or detect a material misstatement in a timely manner. The only risk that an auditor can control is detection risk. Therefore, the auditor needs to plan the audit so that the detection risk will be at the level needed to create a level of audit risk that is acceptable. For instance, if inherent risk and control risk are high, then the auditor must develop an audit plan that has a very low level of detection risk.

Question 173: Some account balances, such as those for financial instruments, are the results of complex calculations. The natural risk of material misstatements in these types of accounts is called:

- a) Control risk.
- b) Inherent risk.
- c) Audit risk.
- d) Detection risk.

(CMA Adapted)

Question 174: In assessing relative risks, internal auditors should be least concerned with:

- a) Statistical sampling techniques.
- b) Compliance with internal and external rules and regulations.
- c) Reliability and integrity of information.
- d) Safeguarding of assets.

(CMA Adapted)

Question 175: Inherent risk is:

- a) The risk that the auditor may unknowingly fail to appropriately modify his opinion on financial statements that are materially misstated.
- b) The risk that the auditor will not detect a material misstatement that exists in an assertion.
- c) The susceptibility of an assertion to a material misstatement, assuming that there are no related internal control structure policies or procedures.
- d) The risk that a material misstatement that could occur in an assertion will not be prevented or detected on a timely basis by the entity's internal control structure policies or procedures.

(CMA Adapted)

Question 176: Control risk is the risk that a material misstatement in an account will not be prevented or detected in a timely basis by the client's internal control structure policies or procedures. The best control procedure for preventing or detecting fictitious payroll transactions is:

- a) Personnel department authorization for hiring, pay rate, job status and termination.
- b) To use and account for prenumbered payroll checks.
- c) Periodic independent bank reconciliations of the payroll bank account.
- d) Storage of unclaimed wages in a vault with restricted access.

(CMA Adapted)

Understanding Internal Controls in the Planning of the Audit

After the engagement objectives are determined and the inherent risks identified, the starting point for most engagements is the understanding of internal controls. Without an understanding of the internal control system that is in place, the auditor will not really know what should be happening in the process and what the objectives of that process are. Also, the understanding of the internal control system will identify areas of additional concern where the controls are insufficient or not properly implemented.

The auditor's understanding needs to **encompass the 5 components of internal control**: 1) the control environment; 2) risk assessment; 3) control activities; 4) information and communication; and 5) monitoring.

While the scope of internal controls is great, in any specific engagement, the auditor will be looking most closely at the controls that are relevant to the engagement that is taking place. For example, continuing our accounts receivable, example, inherent risk no. 3 is: **"After receipt in the processing area, the checks are exposed to loss there until the bank deposit has been prepared."** Controls for that risk would include a procedure of locking checks up as soon as received and keeping them locked up until the person charged with preparing the deposit is ready to process them. And they are to be locked up at all times unless the person processing them is actually in the processing area and is working on the checks. For example, if the employee is working on the checks and needs to leave the desk, even if for just a minute, he or she is to lock the checks up before leaving the desk.

The auditor will use this understanding of the relevant internal controls to:

- 1) Identify the types of potential misstatements that may occur in whatever he or she is auditing,
- 2) Consider the factors that relate to the risk of material misstatements, and
- 3) Design the substantive tests that will be performed. The internal controls that are in place and operating effectively will impact the nature, timing and extent of the substantive tests that the auditor will perform.

In obtaining an understanding of the internal controls, an auditor will consider knowledge obtained from other sources or audits, assessments about the inherent risk of an item, materiality and the size and complexity of the operations.

A company that is smaller and has very straightforward operations will most likely need, and have, a less formal internal control process. This is because the nature of the company and its operations are in themselves an internal control.

The auditor will need to evaluate not only the design of the controls, but **also whether or not the controls have been implemented**. If a wonderfully designed system is not being used, it is not providing any assurance about the accuracy of the accounting information or anything else.

The internal auditor will most likely also **document their understanding of internal controls**. This may be done in the form of a flowchart (discussed in more detail below), questionnaire or narrative description that will reflect the auditor's understanding of the system. If the auditor decides that he or she is not going to rely on the internal control system to detect errors, the system doesn't need to be tested, but the document will illustrate the auditor's understanding of the system.

Flowcharting

One of the methods available to an internal auditor for documenting his/her understanding of the company's internal controls is describing them by means of a flowchart. A flowchart also enables the auditor to identify areas in which internal controls are required and necessary for the company.

The main elements that are shown in a flowchart are:

- Data sources (where the information comes from);
- Data destinations (where the information goes);
- Data flows (how the data gets there);
- Transformation process (what happens to the data); and
- Data storage (how the data is stored for the long term)

There are two main types of flowcharts.

- 1) A **systems, or horizontal flowchart**, shows the different departments or functions involved in a process, horizontally across the top. It documents the manual processes as well as the computer processes and the input, output and processing steps.

A horizontal flowchart identifies specific **control points** in the system. A **control point** is a point in a process where an error or irregularity is likely to occur, creating a need for control. For example, in the invoicing department, the supervisor may be required to review the invoices for completeness and accuracy before they are sent out.

This type of flowchart clearly shows the segregation of duties.

- 2) A **program, or vertical flowchart**, depicts the specific steps in a process and how they will be executed. It does not, however, usually show the system components as clearly as a horizontal flowchart. This type of flowchart is not used much now, as it has been replaced by other more effective techniques.

A **data flow diagram** is a graphic illustration (symbolic) of a system's processes and data flows.

A flowchart is used not only to understand and describe a firm's internal controls, but also to assess the effectiveness of those internal controls. The controls employed in the procedures are of particular interest, and the flowchart identifies specific control points in the system. The auditor will identify each control point and determine whether each one is a **detective** control, a **preventive** control, a **corrective** control or a **compensating** control; and how it is performed, i.e., whether it is an operational procedure, a documentation procedure, an accounting procedure, or a supervisory control.

Note: Computers have made the process of initially creating a flowchart and updating a flowchart much easier. Because of this, you do not need to be familiar with the drawing of or the symbols used in a flowchart.

Question 177: A proper consideration of the organization's internal control structure is an important part of any audit. The results of the consideration of internal controls:

- a) Must be reported to the shareholders in a separate report.
- b) May be used as the basis for determining the acceptable level of detection risk.
- c) Are never reported to client management.
- d) Are not connected to the level of substantive testing to be performed during the audit.

(CMA Adapted)

Question 178: Which one of the following is not an internal control structure policy or procedure relevant to a financial statement audit?

- a) Maintenance of control over unused checks.
- b) Periodic reconciliation of perpetual inventory records to the general ledger control account.
- c) Timely reporting and review of quality control results.
- d) Comparison of physical inventory counts to perpetual inventory records.

(CMA Adapted)

Question 179: According to SAS 78 (AU 319), Consideration of Internal Control in a Financial Statement Audit, only some of an entity's controls are relevant to a financial statement audit. Which one of the following would most likely be considered in such an audit?

- a) Marketing analysis of sales generated by advertising projects.
- b) Maintenance of statistical production analyses.
- c) Timely reporting and review of quality control results.
- d) Maintenance of control over unused checks.

(CMA Adapted)

The Internal Audit Program

The audit program is part of the planning for each audit engagement or project. The audit program details the work to be accomplished, how it will be done and what is to be done and facilitates the supervision and review of the work.

The extent of the audit program depends upon the scope and extent of the work that is to be performed. The larger the project, the more detailed the program needs to be. This scope of the project is determined in the first step in the planning process – establishing the audit objectives and scope of the work.

The program must be prepared before the start of the work, since it is the program that informs the auditors what to do. However, the program can be prepared **only after the auditor has understood the internal control system** that is in place.

The audit program should include information about the **objectives** of the area that is being audited, the risk assessment and a description of the **controls** that are in place as well as those that need to be in place in order to achieve the area's objectives. These area objectives in turn determine the objectives of the audit. The audit program then includes the **procedures**, or the detailed steps, to be carried out in order to reach the objectives of the audit.

This initial program may be adapted from previous audits or it may be a newly designed program. In any case, as the audit progresses, the program may need to be amended or expanded depending upon the findings as the audit is performed. If the auditor finds that work on the audit needs to be expanded, the cause for that expansion must be investigated to make sure that there is not some sort of problem or weakness in internal controls that should be addressed.

Question 180: A standardized internal audit program is inappropriate for which situation?

- a) Follow-up inventory audits performed at the same location.
- b) A complex and changing business environment.
- c) Multiple locations with similar operations.
- d) A stable operating environment undergoing only minor and infrequent changes.

(CIA Adapted)

Question 181: Audit programs that test internal controls should:

- a) Be general so that they may be used at all locations of a particular department.
- b) Be developed specifically for the audit of each operation.
- c) Be general so that they fit all situations without regard to departmental lines.
- d) Reduce duplication of effort by ensuring that every aspect of an operation is examined.

(CIA Adapted)

Question 182: An internal auditor has just completed an on-site survey to become familiar with the company's payroll operations and the applicable internal controls. What step should be performed next?

- a) Establish the initial audit objectives.
- b) Conduct the fieldwork.
- c) Assign audit personnel to the engagement.
- d) Write the audit program.

(CIA Adapted)

Audit Evidence

In performing the audit, the auditor should collect, analyze, interpret and document information to support audit results.

Standards for Audit Evidence

The tests that are performed as part of the audit should provide the auditor with **sufficient, competent, relevant and useful evidence** in order to determine a conclusion about the operations under audit.

- 1) **Sufficient** means enough information that another person would come to the same conclusions as the auditor. **Sufficient** evidence is adequate in both **quantity** and **quality** to allow the auditor to reach a conclusion.
 - Sufficient evidence is factual, adequate and convincing
 - If sampling is used, the samples should be selected by means of objective, acceptable sampling methods and should provide reasonable assurance that they are representative of the population.
- 2) **Competent** means that the information is **reliable** and the best available, given the means used.
 - An original document is more competent than a copy.
 - An oral statement that has been corroborated^Y by other evidence is more competent than one that has not been corroborated.
 - Direct evidence is more competent than hearsay evidence.
 - Evidence that has been produced by a computer should be evaluated carefully.
- 3) **Relevant** means that the information supports the findings and is consistent with the audit objectives. To be relevant, the facts must have a logical relationship to whatever they are being used to prove or disprove.
 - An original purchase order, even if it has been properly approved and issued, has no relevance to a conclusion that the items on the purchase order have actually been received.
 - A receiving report that certifies that the items were received has no relevance to a conclusion about whether the items met the stipulated specifications.
- 4) **Useful** means that it is helping the organization meet its goals. Evidence that meets the tests of being sufficient, competent and relevant is useful evidence.

Classifications of Evidence

Evidence can be classified according to legal rules of evidence. These are pertinent in a fraud audit, because the evidence could wind up as evidence in court. Legal rules of evidence include:

- **Direct** evidence, or evidence that was acquired directly by the party offering it and thus that party has personal knowledge of it. The person either inspected the documents, witnessed the transaction or testified as to his or her actions.
- **Hearsay** evidence, in contrast to **direct** evidence, is a secondhand account where the witness does not have personal, direct knowledge of what occurred but heard it from someone else.
- **Documentary** evidence is any original record, deed, contract or written instrument that documents a transaction. Originals of documentary evidence are required to substantiate their validity.
- **Opinion** is not generally considered useful evidence. However, occasionally experts' opinions are used in areas that are beyond the knowledge of most people.

^Y To **corroborate** means to confirm, to make more certain, to support or validate. **Corroborating evidence** is evidence that supports and confirms other evidence.

- **Circumstantial** evidence may be used when direct evidence is unavailable. Circumstantial evidence is evidence that is consistent with a particular inference. Circumstantial evidence can be used to narrow competing explanations, but it is not persuasive in demonstrating fact. It can only be supportive evidence.
- **Secondary** evidence is evidence that is not the original documentation. Secondary evidence may at times be the only evidence available. In the absence of original, documentary evidence, a court may accept photocopies or other **secondary evidence** if they are the best available evidence.
- **Corroborative** evidence supports other evidence. The greater the amount of corroborating evidence, the more persuasive it is. Several witnesses can corroborate each other's testimony, for example, and their testimonies taken together are more persuasive than one person's testimony.
- **Conclusive** evidence is evidence that is indisputable. Direct evidence, well corroborated, may be conclusive evidence.

Question 183: Audit information is considered to be relevant when it is:

- a) Objective and unbiased.
- b) Factual, adequate and convincing.
- c) Consistent with the audit objectives.
- d) Derived through valid statistical sampling.

(CIA Adapted)

Question 184: What standard of evidence is satisfied by an original signed document?

- a) Sufficiency.
- b) Relevance.
- c) Usefulness.
- d) Competence.

(CIA Adapted)

Question 185: In conducting internal audits, secondary evidence is used to support primary evidence. Secondary evidence may include a copy of written evidence or oral evidence. Which one of the following is the weakest form of supportive evidence?

- a) Conclusive evidence.
- b) Circumstantial evidence.
- c) Expert opinion evidence.
- d) Corroborative evidence.

(CMA Adapted)

Question 186: Internal auditors frequently use interviewing techniques. When considering the potential use of interviewing to gather audit evidence, auditors should be aware that interviews:

- a) Provide a systematic format to ensure audit coverage.
- b) Should be corroborated by gathering objective data.
- c) Are best suited to reaching audit conclusions.
- d) Are more objective than questionnaires in gathering data.

(CIA Adapted)

Question 187: Operational audits are designed to:

- a) Review performance of an organization or some portion of an organization (e.g., department, function, etc.) using some pre-established standard as the primary evaluation criterion.
- b) Produce an opinion on the fairness of the firm's financial statements.
- c) Produce an opinion on the accuracy of a firm's financial accounting system.
- d) Identify specific faults in a manager's performance.

(CMA Adapted)

Question 188: Which one of the following items is included in an operational audit but is not required in a financial audit conducted by an external auditor?

- a) Supervision of the audit team's activities and output.
- b) Fact-finding, analysis, and documentation.
- c) Reporting on the findings.
- d) Recommendations for improvement.

(CMA Adapted)

Question 189: An example of the subject of an operational audit would be:

- a) The income tax return information of a manufacturer.
- b) The performance statistics on the delivery of a city's services.
- c) The verification of the dollar amount of royalties due to the developer of a manufacturing process from the user of that process.
- d) The 5-year revenue and expenses forecast by an entrepreneur seeking to raise venture capital for his prospective operation.

(CMA Adapted)

Question 190: When auditing purchases, which of the following is usually considered a risk factor?

- a) Purchases are made against general or open purchase orders for some items.
- b) Purchase specifications are developed by the department requesting the material.
- c) There is a failure to rotate purchases among suppliers included on an approved vendor list.
- d) Purchases are made from parties related to buyers or other company officials.

(CIA Adapted)

Question 191: In conducting an operational audit, which one of the following activities would not be expected of the internal auditor?

- a) Make an objective observation and comprehensive analysis of specific activities.
- b) Perform the operational activity of the line personnel.
- c) Observe performance of personnel.
- d) Assess performance as compared with established policies.

(CMA Adapted)

Question 192: The primary difference between operational auditing and financial auditing is that in operational auditing:

- a) The auditor starts with the financial statements of an activity being audited and works backward to the basic processes involved in producing them.
- b) The auditor is seeking to help management use resources in the most effective manner.
- c) The auditor is not concerned with whether the audited activity is generating information in compliance with financial accounting standards.
- d) The auditor can use analytical skills that are not necessary in financial auditing.

(CIA Adapted)

Question 193: Internal auditors are often called upon to either perform, or assist the external auditor in performing, a due diligence review. A due diligence review is:

- a) A review of financial statements and related disclosures about a potential acquisition.
- b) A review of operations as requested by the audit committee to determine whether the operations comply with audit committee and organizational policies.
- c) A review of interim financial statements as directed by an underwriting firm.
- d) An operational audit of a division of a company to determine if divisional management is complying with laws and regulations.

(CIA Adapted)

Audits of Financial Controls

The Sarbanes-Oxley Act requires management to assess the adequacy of the company's internal controls over financial reporting. Internal auditors can assist in this through an audit of financial controls.

Types of Controls

The types of controls needed and therefore the type of auditing needed will vary with management objectives, and therefore internal auditors may assume varying roles. An example is accounts receivable.

First scenario: Management has decided to increase sales by loosening its credit policies. In fact, the company is going to offer credit to every customer without doing any credit checks. Therefore, the control system must be designed to provide continuous monitoring of accounts receivable agings in order to detect past due accounts. Past due accounts are then flagged so the customers will not receive any more credit, in order to cut the losses quickly.

The role of the internal auditors is not merely to check whether procedures are being followed, but to determine whether this ongoing monitoring is being performed effectively. Are the agings being prepared in a sufficiently timely manner? Are past due accounts being identified in a reasonable way? Does the sales department have access to information about which customers should not receive further credit? And is the sales department **accessing** and **using** this information?

Second scenario: Management has decided to maintain its current customer base but reduce the amount of bad debts and the cost of carrying receivables. Credit policies are being tightened, and controls over the extension of credit are being strengthened. Credit checks will be required before credit is granted to any customer, and terms to deter delayed payment will be offered. For example, cash discounts will be offered to encourage prompt payment, and late charges will be levied for late payments.

The role of the internal auditors in this case will focus more on the control procedures which act as a filtering device to avoid credit losses and on whether they are being followed. The internal auditor will still need to monitor things such as agings of accounts receivable. However, the audit orientation will be more toward existing "front-end" procedures and whether they are being followed.

Cost-benefit considerations are an important part of the decision of what controls to institute. In the first scenario above, credit checks on new customers in an expanding customer base was deemed to be too costly for the benefit that would be derived from it. It was determined that it would be less costly to stay on top of the past due accounts and refuse those customers any further credit in order to cut the losses from them. The payoff was increased sales and (presumably) profits. In the second scenario, it was deemed too costly **not** to do credit checks on new customers. This is a management decision, and the internal auditor's role will depend upon management's objectives.

The cost-benefit ratio of every control objective should always be considered before the control objective is set. By considering the cost-benefit ratio, objectives can be designed to be achievable and compatible with both operating and control-related goals.

The costs and benefits need to be expressed in dollars to be meaningful. For example, a certain control may be expected to be 90% effective in deterring employee theft. It will require one hour of an employee's time per week. If the exposure to employee theft is judged to be \$100,000 per year and the employee's time costs \$15 per hour for one hour per week, the cost of this control is $\$15 \times 52$, or \$780 per year. The expected savings are 90% of \$100,000, or \$90,000. Clearly, that particular control should be installed. However, if the potential loss is low and the cost of the control is higher than the potential loss, then the cost-benefit ratio of that control does not warrant instituting the control.

Accounting Controls Versus Administrative Controls

A financial audit will focus on accounting controls. An operational audit will focus on administrative controls.

Accounting controls are concerned with the integrity and accuracy of the accounting system and the financial reports being generated, as follows:

- **Completeness:** Are all of the transactions reflected in or captured by the accounting system?
- **Validity:** Are only valid transactions recorded?
- **Authorization:** Are all transactions properly authorized?
- **Accuracy:** Are reported numbers accurate representations of the economic transactions that have occurred?

Administrative controls are more focused on management's operating objectives. For example, outside salespeople might be required to submit reports on how many customer calls they make each week. This is a control over the operating goal of providing good customer service and increasing sales, but it has no direct control effect on the reported accounting numbers.

Objectives of an Audit of Controls

An audit of controls has the following objectives:

- 1) To determine whether controls are in place;
- 2) To determine whether the controls that are in place are structurally sound;
- 3) To determine whether the controls are designed to achieve a specific management objective, to achieve compliance with predetermined requirements, or to ensure accuracy and propriety of transactions;
- 4) To determine whether the controls are being used properly;
- 5) To determine whether the controls are efficiently serving their purpose;
- 6) To determine whether the controls are effective;
- 7) To determine whether management is using the output of the control system;

Testing Compliance with Controls

To test compliance with controls and evaluate their effectiveness, the auditor should investigate the following:

- 1) Are procedures being followed?
- 2) Is the output being used?
- 3) Is the input into the system valid, accurate, and reasonable?
- 4) If the system is computerized, is it operating properly?
- 5) Is the output of the control operation valid?
- 6) Is the control output achieving management's objective in establishing the control?
- 7) Is the control system operating as intended?
- 8) Does the control system have the following required characteristics?
 - a. Flexibility.
 - b. Timeliness.
 - c. Accountability.
 - d. Cause identification.
 - e. Appropriateness.
 - f. Placement.

Procedures the auditor performs to test operating effectiveness of controls include a mix of tests. Some types of tests produce greater evidence of the effectiveness of the controls than other tests. Here are the tests that an auditor might perform in order of the evidence they would usually produce, from **least evidence** to **most evidence**:

- 1) Inquiry of appropriate personnel;
- 2) Observation;
- 3) Inspection of relevant documentation; and
- 4) Re-performance of a control.

Inquiry alone does not provide sufficient evidence to support a conclusion about the effectiveness of a control.

Testing controls over a greater period of time provides more evidence of the effectiveness of the controls than testing over a shorter period of time does. The tests of controls should be performed as close to the “as of” date of the management assessment of controls over financial reporting as possible, balanced with the need to test the controls over a sufficient period of time to obtain sufficient evidence of their operating effectiveness.

Control Breakdowns

If an internal auditor identifies a material weakness that could cause a control breakdown, this information should be included in the auditor’s report. The auditor may choose to issue an interim report or may decide to wait and include the information in the final report. Generally, interim reports should be issued whenever there is something that needs to be addressed immediately. So if a control breakdown needs to be addressed immediately, an interim report should be issued. Interim reports are covered under the topic of “Internal Audit Reports,” below.

If an internal auditor identifies a deficiency in a control over financial reporting, the auditor should evaluate the severity of the deficiency to determine whether the deficiency, either individually or in combination with other deficiencies, represents a material weakness as of the date of the management assessment. The severity depends upon:

- Whether there is a **reasonable possibility** that the company’s controls will fail to prevent or detect a misstatement of an account balance or disclosure; and
- The magnitude of the potential misstatement resulting from the deficiency or deficiencies.

The auditor should evaluate the effect of compensating controls when determining whether a control deficiency is a material weakness. In order to have a mitigating effect, a compensating control should operate at a level of precision that would prevent or detect any misstatement that would be material.

Risk factors affect whether there is a reasonable possibility that a deficiency or a combination of deficiencies will result in a misstatement of an account balance or disclosure. These risk factors include:

- The nature of the financial statement accounts, disclosures, and assertions involved;
- The susceptibility of the related asset or liability to loss or fraud, or how likely it is that something could go wrong;
- The subjectivity, complexity, or extent of judgment required to determine the amount involved;
- The interaction or relationship of the control with other controls, including whether they are interdependent or redundant;
- The interaction of the deficiencies, i.e., if there is more than one, could they in combination cause a material misstatement; and
- The possible future consequences of the deficiency.

If multiple control deficiencies affect the same financial statement account balance or disclosure, that increases the likelihood of misstatement and may, in combination, constitute a material weakness, even though each deficiency individually may not be severe.

Factors that affect the magnitude of the misstatement that might result from a deficiency or deficiency in controls include:

- The financial statement amounts or total of transactions exposed to the deficiency; and
- The volume of activity in the account balance or class of transactions exposed to the deficiency that has occurred in the current period or that is expected in future periods.

The maximum amount that an account balance or transaction total could be overstated is generally the recorded amount, or 100% of the account balance. Understatements could be larger than the amount of the account balance and can be unlimited. However, in many cases, the probability of a small misstatement will be greater than the probability of a large misstatement.

Detection and Prevention of Fraud

The internal auditor is responsible for examining the controls that are in place to determine if they are adequate to prevent or detect fraud, and the internal auditor is also responsible for examining for fraud. However, the internal auditor is not responsible for preventing fraud. Because of the fact that people may work together to get around the system and its controls, it is impossible for anyone to guarantee that there is not and will not be fraud.

It is preferable to prevent fraud through using controls rather than detecting fraud after the fact; however, this may not always be possible.

If fraud is suspected, the internal auditor should notify the appropriate management level within the organization.

Note: In cases of fraud, the internal auditor is interested in how the fraud occurred, what needs to be fixed in the controls, and what needs to be done to prevent it again in the future.

The factors that contribute to fraud are varied and numerous, but by being aware of them, the auditor is in a better position to detect and prevent fraud by knowing where it may occur. Some of the factors contributing to fraud are insufficient internal controls in general. Specifically, these are:

- 1) No segregation of duties;
- 2) Not limiting the access to assets;
- 3) Failing to compare existing assets with recorded assets;
- 4) Executing transactions without proper authorization;
- 5) Lack of personnel or qualified personnel that leads to improper controls;
- 6) Collusion among employees;
- 7) The existence of high-value, small, liquid assets; and
- 8) The ability of management to override the controls in place.

The Institute of Internal Auditors' (IIA's) position on deterrence, detection, investigation and reporting of fraud is:

- 1) The deterrence of fraud is the responsibility of management.
- 2) Internal auditors must have sufficient knowledge to be able to identify the indicators that fraud may have occurred.
- 3) If control weaknesses are detected, additional tests should be performed to identify other factors of fraud that may be present.
- 4) Audit procedures alone will not guarantee that fraud will be detected.
- 5) A fraud that is detected needs to be reported.

Question 194: When comparing perpetrators who have embezzled company funds to perpetrators of financial statement fraud (falsified financial statements), those who have falsified financial statements would be less likely to:

- a) Be living beyond their obvious means of support.
- b) Rationalize the fraudulent behavior.
- c) Use company expectations as justification for the act.
- d) Have experienced an autocratic management style.

(CIA Adapted)

Consideration of Fraud in the Planning of a Financial Statement Audit

The auditor should develop and plan the audit with a reasonable assurance of detecting material fraud or misstatements. However, due to the fact that the perpetrators of fraud will try to hide the fact, it is not possible to guarantee discovery of material frauds.

Fraud is different from an error in that fraud is an intentional misstatement while an error is unintentional. The three main types of fraud are:

- 1) **Misstatements arising from fraudulent financial reporting**
Fraudulent financial reporting involves **intentional** misstatements in the financial statements that are made to mislead users. This includes omission of information from the financial statements and a misapplication of accounting principles.
- 2) **Misstatements arising from the misappropriation of assets (stealing)**
This includes theft, embezzlement and any action that causes the company to expend cash for things that will not benefit the company.
- 3) **Corruption**
This includes bribes, kickbacks, conflicts of interest and other things that prevent an employee from acting fully and morally on the behalf of the company.

As the auditor is supposed to find material misstatements, the risk of misstatement due to fraud needs to be specifically considered in the planning of the audit.

Management conditions or the desires of individuals to meet goals, industry conditions, the regulatory environment and the nature of the business will all influence the risk of fraudulent reporting. A major risk factor that could indicate possible fraudulent financial reporting is the occurrence of **management override of controls**. Studies have shown that in cases of fraudulent financial reporting, management has been able to repeatedly override systems of internal accounting control.

The types of controls and assets a company has will influence the risk of the misappropriation of assets.

The auditor will also inquire of management about their understanding of the risks and their knowledge of any frauds that are being, or can be committed, within the company.

When an internal auditor suspects fraud, he or she should determine the possible effects and discuss the matter with the appropriate level of management who should then initiate an investigation. When wrongdoing is suspected, the auditor's responsibility extends to the **appropriate level of management** within the organization. It is generally not the auditor's duty to report this to individuals outside of the organization, although the auditor may in some cases need to report this event to the SEC, a predecessor auditor, a court or to a governmental agency.

Question 195: Which of the following policies is most likely to result in an environment conducive to the occurrence of fraud?

- a) The division's hiring process frequently results in the rejection of trained applicants.
- b) Budget preparation input by the employees who are responsible for meeting the budget.
- c) The application of some accounting controls on a sample basis.
- d) Unreasonable sales and production goals.

(CIA Adapted)

Question 196: When conducting fraud investigations, the internal audit function should:

- a) Assess the probable level of and the extent of the fraud within the organization.
- b) Assign personnel to the investigation based on the audit schedule established at the beginning of the fiscal year.
- c) Clearly indicate the extent of internal auditing's knowledge of the fraud when questioning suspects.
- d) Perform its investigation independent of lawyers, security personnel and specialists from outside the organization who are involved in the investigation.

(CIA Adapted)

Internal Audit Reports

Audit reports may take many different forms and they may be issued for many different types of projects. They may be formal or informal, written or oral, interim reports, final reports, or summary reports. The format of the report will depend upon the type of the audit, the results of the audit, what management needs, the nature of the company and how internal audit is accepted by the various levels of the organization.

However, there are some similarities between all of the different types of reports. All reports must include the purpose, the scope, the results and (if appropriate) an opinion.

In addition to these items, a report may also include any of the following items:

- Background information and summaries,
- The status of findings from previous audits,
- Recommendations of potential improvements,
- Acknowledgement of good performance and corrective actions taken, and
- Comments from the department that was audited.

Oral Reports and Interim Reports

Oral reports should **supplement** written reports **but do not replace** written reports. Oral reports are timelier (and this is essential for a problem that needs to be immediately fixed) and will help develop the relationship between the auditor and the auditee through increased, informal communication. More timely oral reports also enable the auditee to point out any errors in the logic or understanding that the auditor used in coming to the conclusion that has been reached.

Despite the flexibility of oral reports, they still require adequate preparation to gain the maximum benefit.

Interim reports are issued during the process of the audit. "Interim report" does not mean that these are reports that are issued with the interim financial statements. Interim reports should be issued whenever there is something that needs to be addressed immediately or if there is a need to change the scope of the audit. Or one may be issued simply to keep people informed when the audit process is a long one.

Because they are not final reports, interim reports should state that they include only information to date, not complete reporting. They should also state that the final report will follow-up on, and cover, all remaining issues from the audit.

Preparing the Final Written Internal Audit Report

The chief audit executive must communicate results to the appropriate parties (*Internal Auditing Standard No. 2440*). This means that the chief audit executive or designee must review and approve the final engagement communication before issuance and decide to whom and how it will be disseminated.

Except for very simple reports, the auditor should first prepare a brief outline of the report, including main headings such as Summary, Forward, Purpose, Scope, Opinion and Findings. Each finding may require an additional outline in order to properly explain and address it. All reports should be

- Objective,
- Clear,
- Concise (no longer than necessary),
- Timely, and
- Constructive (helpful to the company and leading to some sort of improvement).

Contents of the Final Report

At a minimum, the final report should contain the **purpose, scope and results** of the engagement (discussed more fully below). Also, where appropriate, the report should contain the internal auditor's overall opinion.

The final communication may include background information and summaries. Background information may identify the organizational units and activities reviewed and provide relevant explanatory information. It may also include the status of observations, conclusions and recommendations from prior reports and an indication of whether the report covers a scheduled engagement or is responding to a request. Summaries, if included, should be balanced representations of the engagement communication's content.

The final report should be signed by either the chief audit executive or a person who is designated to sign the report.

Purpose of the Engagement

In this section of the report, the auditor outlines the engagement objectives (this must always be included in the report) and also may include why the engagement was performed and what the expected results were from the engagement (i.e., cost savings, increased efficiencies, etc.). The audit objective should be described in enough detail so that readers will know what to expect from the rest of the report. The objectives should be spelled out, and then the findings should address themselves to each statement in the objectives.

The engagement's objectives also should address the risks, controls and governance processes associated with the activities under review.

Scope of the Engagement

The scope of the engagement is a description of how much work was done to achieve the engagement's objectives. This section outlines what was done on the engagement, including:

- The activities that were reviewed;
- The time period reviewed (if appropriate);
- Any related activities that were **not** reviewed; and
- The nature and extent of the work performed.

The scope of the engagement should specifically state what areas were **not** covered by the audit that readers would expect to be covered by the audit unless told differently.

The scope of the engagement must include consideration of relevant systems, records, personnel, and physical properties, including those under the control of third parties (*Internal Auditing Standard No. 2220.A1*).

In performing consulting engagements, internal auditors should ensure that the scope of the engagement is sufficient to address the agreed-upon objectives. If internal auditors develop reservations about the scope during the engagement, these reservations should be discussed with the client to determine whether to continue with the engagement. A scope limitation occurs when the auditor is unable to perform all of the required procedures. The cause of the scope limitation is not important. Any scope limitations should be reported.

Results of the Engagement

This section includes the **observations, conclusions (or opinions if appropriate), recommendations and action plans** from the engagement.

- 1) **Observations** are the relevant statements of fact, or **audit findings**, discovered during the engagement. These observations are made as a result of comparing the difference between the current state of affairs (**what is**) with the ideal state of affairs (**what should be**). Any observations that are essential to the understanding of the conclusion should be included in the final report. Other less material or less significant observations can be communicated in less formal ways.

An audit finding should include certain elements: **Background, criteria, condition, cause, and effect**.

- a. **Background:** The person reading the report must be given enough background about the situation in order to understand the reasons why the auditor believes the finding should be reported. Background can identify the people involved, the organization's relationships, and objectives and goals concerned. It should describe the environment of the operation and the reason why the situation is important enough to be reportable.
- b. **Criteria:** The criteria are the standards used to judge the operation being audited. They should include goals and/or objectives that management has for the audited operation, i.e., what the audited operation should be accomplishing. This is the "**what should be**." The goals and objec-

tives may include operating standards. In order to appraise an operation, it is necessary to have an understanding of its goals and/or objectives.

- c. **Condition:** The condition is the heart of the audit finding. This is the “**what is.**” It refers to the facts determined by the internal auditor through observation, questioning, analysis, verification and investigation. The information about the condition should be sufficient, competent and relevant. The condition should be representative of the total population or system under review. Or, if it is an isolated instance, it should be reported as a significant defect. The condition is the facts upon which the conclusions are based, and the facts presented should be indisputable.
- d. **Cause:** Every audit finding is caused by some difference between “what is” and “what should be.” The cause explains the **reason** for deviations from the criteria, or **why** “what is” is different from “what should be.” Unless the cause is identified, the situation cannot be corrected.
- e. **Effect:** Effect gives the **consequences** of the difference between “what is” and “what should be.” It answers the question, “**So what?**”. An audit finding should not be merely some deviation from procedures. In order to be reportable, an audit finding should have consequences. “Effect” tells who or what was hurt, and how badly. Effect is the element of an audit finding that is required in order to convince the client and senior management that if the undesirable condition continues, it will cause serious damage and would create more costs than the cost of the action needed to correct the problem. If the finding is an economy or efficiency finding, the effect should be measured in dollars. If the finding is an effectiveness finding, the effect is the organization’s inability to accomplish some desired or required result. **Effect is an essential part of an audit finding.** Without it, the chances that corrective action will be taken are slim.

If the engagement finds that everything that is supposed to happen is actually happening, then this satisfactory performance should also be communicated in the report.

- 2) **Conclusions** are the internal auditor’s evaluations of the effects of the observations and recommendations on the activities that were reviewed. These may state whether a function is operating as intended, if control criteria are being met, if objectives and goals are being met, etc.
- 3) The report should include **recommendations** for improved performance, acknowledgement of satisfactory performance and any **action plans** for corrective actions that need to be implemented. The recommendations are based on the observations and conclusions of the internal auditor. The suggested corrective actions may be very specific about what needs to be done or more general, such as the identification of areas for further study.

The final report may also include improvements that have been made or implemented by the auditee since the last engagement.

Summary Reports

A summary report may be issued **in addition to** the full audit report. The purpose of a summary report is to inform senior management on a timely basis about significant findings of the audit activity. A summary report can be a report of one or two pages in length that informs senior management of what matters the auditors have discovered that need prompt or continued attention. Audited units that are doing well need no senior management attention, so summary reports should concentrate on the exceptions and problems that need attention.

Summary reports can be issued for each completed internal audit. Internal auditors should ask senior management what information they want to know about completed audit projects and include that in the summary report.

Generally, an executive summary of a completed audit should include the following:

- A brief description of the audit;
- Conclusions;
- Summary statements of significant findings, with references to the page numbers in the full audit report where detail can be found; and
- A brief description of the actions that have been taken by the client as a result of the audit findings.

Summary reports have the advantage of prompt reporting. However, a disadvantage is that they have the potential to cause unfavorable auditor-client relations because they concentrate on reporting defects. This adverse effect can be offset by making some overall objective comments, as well.

Report Review and Distribution

It is a courtesy to **review the report with the person or department being audited** so that the auditee knows what is being sent to his or her supervisors and will not be surprised by the report. **This review may also allow the auditee to identify any inaccuracies in the report.**

During this meeting between the auditor and the auditee, the auditor is the person leading the meeting and needs to be prepared for any disagreements or conflicts that may arise as a result of the audit report. **In no circumstances will the auditor allow the auditee to write or change the report** – this is the auditor's responsibility. **Notes should be kept from any review meeting, with a record of any conflicts or disagreements and their resolution.**

The report should be distributed to everyone who has a direct interest in the audit. This includes the executive or executives to whom internal audit reports, the person to whom people will reply about the report, persons responsible for the activities or operations audited, and those who will need to take corrective action as a result of the audit.

When it is distributed, it should include a **list of people to whom it was distributed** and who reviewed it during the draft stage.

Information that is sensitive, privileged or proprietary should be **disclosed in a separate report and delivered to the audit committee.**

Question 197: The internal auditing department for a chain of retail stores recently concluded an audit of sales adjustments in all stores in the southeast region. The audit revealed that several stores are costing the company an estimated \$85,000 per quarter in duplicate credits to customers' charge accounts. The audit report, published 8 weeks after the audit was concluded, included the internal auditors' recommendations to store management that should prevent duplicate credits to customers' accounts. Which of the following standards for reporting has been disregarded in the above case?

- a) Auditor recommendations should not be included in the report.
- b) The auditors should have implemented appropriate corrective action as soon as the duplicate credits were discovered.
- c) The follow-up actions were not adequate.
- d) The report was not timely.

(CIA Adapted)

Types of Incidents That Should Be Reported

When reporting on the results of their work, internal auditors should reveal all **material facts known to them** which, if not revealed, could either **distort reports of operations** under review or **conceal unlawful practices**. Any variance between "what should be" and "what is" should be reported. Examples of incidents that should be reported include but are not limited to:

- 1) **Fraud.** If fraud is suspected, the internal auditor should notify the appropriate level within the organization. This level is always at least one level above where the fraud is suspected.
- 2) **Violation of any law**, such as environmental regulations.
- 3) In a **quality** audit, **inconsistent product quality** that may cause a loss of market share.
- 4) A situation in which no control failure has occurred, no illegal activity is going on, and no accounting errors have occurred may also be a reportable situation in certain circumstances. For instance, if an auditor discovers that a major supplier is not offering the organization a discount for early payment when the auditor knows that the supplier is offering discounts to other companies on similar purchases, the goal of efficiency would indicate that he or she report this information to management.

Auditor Follow-Up

Internal Auditing Standards require that internal auditors **follow-up on the actions taken by auditees in regards to any deficiencies found**. The auditor should determine that either corrective action has been taken, or that management has assumed the risk of not taking corrective action.

In order to follow-up, the auditor should receive all of the replies from the auditees, evaluate whether those replies are adequate and then be certain that actions will be and are actually taken to correct the problems. In order to ensure that the actions have been taken, the auditor may need to do additional testing after the correction has been put into place.

The auditor is the best person to carry out this necessary step because he/she is more familiar with the situation – and the potential risks – than management; furthermore, the auditor should be more impartial and objective than the manager who has to make the changes.

For this process to be effective, the auditor needs to report to management when corrective actions have not been taken, have not been timely or are not effective. In addition, the auditor needs to follow-up on those audit findings that have not been addressed. A satisfactory response is one that addresses the whole problem and shows that action has been taken to prevent the recurrence of the deficiency.

If this system is to work to its fullest, there must be a process by which all audits are kept open until each deficiency has been addressed, through either correction or assumption of the risk by management. When the audit is closed, the auditor should issue a formal statement of closure directed to the chief audit executive. In addition, there should be a follow-up report distributed to the same parties who received the audit report, informing them of the results of any corrective action taken.

Question 198: The internal auditor should follow up to ascertain that appropriate action is taken on deficiency findings. To accomplish this, the internal auditor should:

- a) Make any field tests needed for assurance that the condition has been corrected.
- b) Limit internal audit follow-up to receiving written confirmation from the auditee that appropriate corrective action has been taken.
- c) Work closely with the external auditor.
- d) Be guided by the wishes of the audit committee.

(CMA Adapted)

Computerized Audit Techniques

Internal auditors use the computer to evaluate the processing being done by the computer and the controls that are in place. There are a variety of tools that auditors can use to audit information systems.

Generalized Audit Software

Generalized audit software (GAS) permits the computer to be used by auditors as an auditing tool. The computer can select, extract, and process sample data from computer files. Generalized audit software can be used on mainframe computers and also on PCs. Generalized audit software can check computations, search files for unusual items, and perform statistical selection of sample data. It can also prepare confirmation requests.

Test Data

Test data is input prepared by an auditor which contains both valid and invalid data. The input is processed manually to determine what the output should look like. The auditor then processes the test data electronically and compares the manually-processed results with the electronically-processed results. Test data is used not only by auditors but also by programmers to verify the processing accuracy of the programs they write and the programming changes they make.

Data used as test data might be real data, or it might be fictitious transactions. Since test data is not data that should actually be processed, it is important to ensure that the test data do not actually update any of the real data files maintained by the system.

Test data can only evaluate programs. Other tests that verify the integrity of input and output are required as well. And the test data usually cannot represent all possible conditions that a computer program might encounter in use. Furthermore, test data can be run only on a specific program at a specific time. Because the test data must be processed separately from other data, the auditor cannot be sure that the program being tested is the same program that is used in actual processing.

Integrated Test Facility

An Integrated Test Facility (ITF) involves the use of test data and also creation of test entities that do not really exist, such as vendors, employees, products, or customers. The fictitious entities are actually included in the system's master files, and the test data are processed concurrently with real transactions. The transactions are processed against live master files that contain the real records as well as the fictitious records.

The major difference between test data and an ITF is that the test data in an ITF are processed along with real data. No one knows that the data being processed includes these fictitious entries to fictitious records. In this way, the auditor can be sure that the programs being checked are the same programs as those that are being used to process the real data.

The difficulty with using the ITF approach is that the fictitious transactions have to be excluded from the normal outputs of the system in some way. This may be done manually, or it may be done by designing or modifying the application programs. Either way, the fictitious transactions must be identified by means of special codes so they can be segregated from the real data. Careful planning is required to make sure that the ITF data do not become mixed in with the real data, corrupting the real data.

If this careful planning is done, the costs of using ITF are minimal, because there is no special processing required and thus no interruption of normal computer activity. There are costs involved in developing an ITF, both while the application is being developed and as later modifications are made to it. However, once the initial costs are past, the ongoing operating costs are low.

ITF is normally used to audit large computer systems that use real-time processing.

Parallel Simulation

Parallel simulation is an audit technique that uses **real data** rather than simulated data but processes it through test or audit programs. The output from the parallel simulation is compared with the output from the real processing. Parallel simulation is expensive and time-consuming and is usually limited to sections of an audit that are of major concern and are important enough that they require an audit of 100% of the transactions. Since parallel simulation is done using test programs, it can be done on a computer other than the one used for the real processing.

Embedded Audit Routines

Embedded audit routines involve modifying a regular production program by building special auditing routines into it so that transaction data can be analyzed. Embedded audit data collection is one type of embedded audit routine, and it uses specially programmed modules embedded as inline-code within the regular program code. The embedded routine selects and records data as it is processing the data for normal production purposes, for later analysis and evaluation by an auditor.

Transactions are selected by the embedded audit routine according to auditor-determined parameters for limits and reasonableness. Transactions that violate those parameters are written to a file as exceptions. Alternatively, transactions might be selected randomly. If transactions are selected randomly, the objective is to create a statistical sample of transactions for auditing.

The approach that selects transactions that violate established limits is called a **system control audit review file (SCARF)**. The approach that selects random transactions is called a **sample audit review file (SARF)**.

It is easier to develop embedded audit routines when a program is initially developed than to add them later.

Extended Records and Snapshot

Many different processing steps may be combined in a program, and therefore the audit trail for a single transaction may exist in several different files. **Extended records** refers to modifying a program to tag specific transactions and save all their processing steps in an extended record, permitting an audit trail to be reconstructed from one file for those transactions. Transactions might be selected randomly, or they might be selected as exceptions to edit tests.

The **snapshot** technique "takes a picture" of a transaction as it is processed. Program code is added to the application to cause it to print out the contents of selected memory areas when the snapshot code is executed. A snapshot is used commonly as a debugging technique. As an audit tool, snapshot code can be used only for transactions that exceed predetermined limits.

Extended records and snapshot are very similar. The difference is that snapshot generates a printed audit trail, while extended records incorporates snapshot data in the extended record file rather than on hard copy.

Tracing

Tracing provides a detailed audit trail of all the instructions executed by a program. A single trace can produce thousands of output records, so the auditor must take care to limit the number of transactions that are tagged for tracing. Tracing might be used to verify that internal controls in an application are being executed as the program is processing data, either live data or test data.

A trace may also reveal sections of unexecuted program code, which can indicate incorrect or unauthorized modifications made to the program.

Mapping

Mapping involves using special software to monitor the execution of a program. The software counts the number of times each program statement in the program is executed. This originally was a technique used for program design and testing, but auditors use it to determine whether program statements are being executed. Mapping can help determine whether program application control statements that appear in the source language listing of the program are actually executed when the program runs and have not been bypassed. It can also locate "dead" program codes and can flag codes that may be being used fraudulently.

Mapping can be used with a program running test data. The output of the mapping program can indicate whether there is unused code in the program. All unused codes are investigated, and the purpose of the unused code is evaluated to determine whether it should stay in the program or be removed.

Systems Controls and Security Measures

Introduction to Systems Controls

When a company uses computers extensively in its operations and accounting systems, this can tend to increase the company's exposure to inaccuracies and fraud.

Since computers apply the same steps to similar transactions, there should be no chance for clerical (human) error in processing. However, if there is a mistake in the program itself, there will be an error in every transaction that is processed using that defective program. And if a clerical error is made in input, it will of course result in an output error.

Potential for fraud is always present in organizations and is a serious problem, even without computer processing of data. The automatic processing of data, the volume of the data processed and the complexity of the processing are aspects of computer processing that can increase both the risk of loss and the potential dollar loss from exposures that would exist anyway. The concentration of data storage creates exposure, as well. The potential for fraud is further increased because of the fact that programs are used for the processing. There is potential for fraud to be committed within the program itself. Without proper controls, this type of fraud may go undetected for a long period of time.

Further complicating the situation is the fact that because of the nature of the system, paper **audit trails** may exist for only a short period of time, since support documents may be periodically deleted. The existence of an **audit trail** means that an amount appearing in a general ledger account can be verified by evidence supporting all the individual transactions that go into the total. The audit trail must include all of the documentary evidence for each transaction and the control techniques that the transaction was subjected to, in order to provide assurance that the transaction was properly authorized and properly processed. When an audit trail is absent, the reliability of an accounting information system is questionable.

On the positive side, computer systems can provide large amounts of information to management in a very short period of time. This will enable management to maintain closer control over the activities of the company and their results.

The objectives of controls for an information system are similar to the objectives of overall organizational internal controls:

- Promoting effectiveness and efficiency of operations in order to achieve the company's objectives;
- Maintaining the reliability of financial reporting through checking the accuracy and reliability of accounting data;
- Assuring compliance with all laws and regulations that the company is subject to, as well as adherence to managerial policies; and
- Safeguarding assets.

Information system internal control guidelines are based upon two documents:

- 1) The report of the Committee of Sponsoring Organizations, *Internal Control – Integrated Framework*, which is discussed in the section of this text titled Internal Control, and
- 2) *Control Objectives for Information and related Technology (COBIT)*, authored by the IT Governance Institute and published by the Information Systems Audit and Control Foundation (ISACF).

In *Internal Control – Integrated Framework*, internal control is defined as a process designed to provide reasonable assurance that the company's objectives will be achieved in the areas of effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations. According to that document, the internal control system is the responsibility of the company's board of directors, management and other personnel.

The internal control system consists of five interrelated components:

- 1) the control environment,
- 2) risk assessment,
- 3) control activities,
- 4) information and communication, and
- 5) monitoring.^z

Control Objectives for Information and related Technology defines control as “the policies, procedures, practices, and organizational structures designed to provide reasonable assurance that business objectives will be achieved and that undesired events will be prevented or detected and corrected.”^{aa} The COBIT document was used as a major resource for this section on systems control.

Common exposures to loss that result from a failure to implement controls include competitive disadvantage, deficient revenues, loss of assets, inaccurate accounting, business interruption, statutory sanctions, erroneous management decisions, fraud and embezzlement, and excessive costs.

The ultimate **responsibility** for internal control lies with management and the board.

Further, controls should be subjected to **cost/benefit analysis**. This means that management should not spend more on controls than the amount the company can expect to receive in benefits from the controls. This is a matter of judgment by management to determine what is required to attain **reasonable assurance** that the control objectives are being met without spending more than can possibly be gained.

Threats to Information Systems

Sources of threats to information systems and data are many. A few of them are:

- Errors can occur in system design;
- Errors can occur in input or input manipulation may occur;
- Data can be stolen over the Internet;
- Data and intellectual property, including trade secrets, can be stolen by employees who carry it out on very small storage media or just email it out;
- Unauthorized alterations can be made to programs by programmers adding instructions that divert assets to their own use;
- Data and programs can be damaged and/or become corrupted, either deliberately or accidentally;
- Data can be altered directly in the data file, without recording any transaction that can be detected;
- Viruses, Trojan Horses, and worms can infect a system, causing a system crash, stealing data, or damaging data;
- Hardware can be stolen;
- Physical facilities as well as the data maintained in them can be damaged by natural disasters, illegal activity or sabotage.

^z *Internal Control – Integrated Framework*, copyright 1992, 1994 by the Committee of Sponsoring Organizations of the Treadway Commission, two volume edition 1994, Vol. 1, pp. 3-5. Used by permission.

^{aa} *Control Objectives for Information and related Technology* (COBIT), 3rd Edition, copyright 2000, IT Governance Institute, www.itgi.org. Reprinted with permission; reproduction without permission is not permitted.

High profile incidents such as the theft of millions of peoples' names and social security numbers from databases have underscored the importance of protecting information systems and data.

The first line of defense against events of this nature and threats such as those above is **effective systems controls**. Controls must be a part of every system and application to preserve the integrity of the data and reduce the risk of loss from poor records, inaccurate accounting, business interruption, fraud, violations of the law, asset loss, and damage to the business's competitive position. The controls must not only exist, but they must also function effectively.

The Classification of Controls

Controls within a computer system are broken down into two types. They are **general controls**, which relate to the environment; and **application controls**, which are controls that are specific to individual applications and are designed to prevent, detect and correct errors and irregularities in transactions during the input, processing and output stages. Both general controls and application controls are essential.

General controls relate to the general environment within which transaction processing takes place. They are designed to ensure that the company's control environment is stable and well managed. A stable and well-managed control environment strengthens the effectiveness of the company's application controls. General controls include controls over the development, modification and maintenance of computer programs, segregation of duties, data security, administrative controls, and provision for disaster recovery. General controls are broken down into the following categories (each is discussed in greater detail below):

- The **organization and operation** of the computer facilities, including provision for segregation of duties within the data processing function as well as segregation of the data processing function from other operations. The IS activity should have a high enough level in the organization and adequate authority to permit it to meet its objectives. There should be a systems control group to monitor production, keep records, balance input and output, and see that work is completed on schedule.
- **General operating procedures**, including written procedures and manuals. Operating procedures also specify the process to be followed in system development and system changes, in order to provide reasonable assurance that development of, and changes to, computer programs are authorized, tested, and approved prior to the use of the program.
- **Equipment and hardware controls**, including controls installed in computers that can identify incorrect data handling or improper operation of the equipment.
- **Access controls** to equipment and data, such as controls over physical access to the computer system and the data that are adequate to protect the equipment and data files from damage or theft.

Application controls are controls that are specific to individual applications. They are designed to prevent, detect, and correct errors in transactions as they flow through the input, processing, and output stages of work. Thus, they are broken down into these three main categories (each of which is discussed in greater detail below):

- **Input** controls
- **Processing** controls
- **Output** controls

Question 199: EDP accounting control procedures are referred to as general controls or application controls. The primary objective of application controls in a computer environment is to:

- a) Provide controls over the electronic functioning of the hardware.
- b) Maintain the accuracy of the inputs, files and outputs for specific applications.
- c) Ensure the separation of incompatible functions in the data processing departments.
- d) Plan for the protection of the facilities and backup for the systems.

(CMA Adapted)

General Controls

Organization and operation of the computer facilities

- An IT Planning or Steering Committee should oversee the IT function. Members should include senior management, user management and representatives from the IT function. The committee should have regular meetings and report to senior management.
- The IT function should be positioned within the organization so as to ensure its authority as well as its independence from user departments.
- Staffing requirements should be evaluated whenever necessary to make sure that the IT function has sufficient, competent staff. Management should make certain that all personnel in the organization know their responsibilities with respect to information systems and that they have sufficient authority to exercise their responsibilities. Responsibilities should be delegated with appropriate segregation of duties, and duties should be rotated periodically at irregularly scheduled times for key processing functions.
- Segregation of duties should be maintained between and among the following functions:
 - 1) Systems analysts
 - 2) Information systems use
 - 3) Data entry
 - 4) Data control clerks
 - 5) Programmers
 - 6) Computer operation
 - 7) Network management
 - 8) System administration
 - 9) Librarian
 - 10) Systems development and maintenance
 - 11) Change management
 - 12) Security administration
 - 13) Security audit

Segregation of duties will be discussed in more detail later.

General Operating Procedures

- Standard procedures for all IT operations, including network operations, should be documented. These should include documentation of the start-up process, job scheduling, processing continuity during operator shift changes, operations logs and procedures that ensure connection and disconnection of links to remote operations.
- Task descriptions should be written for each job function; personnel should be trained in their jobs; assigned duties should be rotated periodically for key processing functions.
- Physical safeguards should be established over forms such as negotiable instruments and over sensitive output devices such as signature cartridges. Sequential numbers on individual forms should be printed in advance so missing forms can be detected.
- The process to follow in system development and system changes should be documented in order to provide reasonable assurance that development of, and changes to, computer programs are authorized, tested and approved prior to the use of the program.
- Turnaround documents should be used whenever appropriate. A turnaround document is a computer-produced document that is resubmitted into the system, such as the portion of an invoice that a customer returns with payment.

Equipment Controls

- A defined backup procedure should be in place, and the usability of the backups should be verified regularly.
- Transaction trails should be available for tracing the contents of any individual transaction record backward or forward, and between output, processing, and source. Records of all changes to files should be maintained.
- Statistics on data input and other types of source errors should be accumulated and reviewed to determine remedial efforts needed to reduce errors.

Equipment Access and Data Access Controls

The responsibility for **logical security** and **physical security** should be assigned to an information security manager who reports to the organization's senior management.

- **Logical security** consists of access and ability to use the equipment and data. It includes Internet security (firewalls) and virus protection procedures; access controls for users to minimize actions they can perform; authentication processes to verify the identity of users; and cryptographic techniques such as encryption of messages and digital signatures.

Unauthorized personnel, dial-up connections and other system entry ports should be prevented from accessing computer resources. Passwords should be changed regularly for all those authorized to access the data. Procedures should be established for issuing, suspending and closing user accounts, and access rights should be reviewed periodically.

All passwords should be issued with levels of authority that permit the users to access only the data that they need to be able to access in order to do their jobs. For example, a person who does invoicing needs access to the invoicing module of the accounting program but does not need access to the general ledger module. The person who does receiving needs access to the purchase order module, but not to invoicing.

- **Physical security** involves things such as keeping servers and associated peripheral equipment in a separate, secure room with bars on the windows and use of blinds or reflective film on the windows for heat blocking as well as physical protection. It also includes password protection for servers; monitoring of hardware components to prevent them from being removed from the premises; security for offsite backup tapes; and biometrics to identify a person based on physical or behavioral characteristics (fingerprints, voice verification, etc.).

Physical security also involves the locations of wiring that connects the system, backup media, and maintenance of uninterruptible power supplies. An IT member should escort visitors when they enter the computer facilities, and a visitor's log should be kept and reviewed regularly.

Media library contents should be protected. Responsibilities for storage media library management should be assigned to specific employees. Contents of the media library should be inventoried systematically, so any discrepancies can be remedied and the integrity of magnetic media is maintained. Policies and procedures should be established for archiving.

Dual access and dual control should be established to require two independent, simultaneous actions before processing is permitted.

Segregation of Duties

The most important organizational and operating control is the **segregation of duties**. Although the traditional segregation practiced in accounting of separating the responsibilities of authorization, record keeping and custody of assets may not be practiced in the same manner in Information Systems (since the work is quite different), there are still specific duties in the IS environment that should be separate from one another.

Separate Information Systems from Other Departments

IS department personnel should be separated from the departments and personnel that they support (called "users"). This means:

- Users initiate and authorize all systems changes, and a formal written authorization is required.
- Asset custody remains with the user departments.
- An error log is maintained and referred to the user for correction. The data control group follows up on errors.

Separate Responsibilities *within* the Information Systems Department

Responsibilities within the Information Systems Department should be separated from one another. An individual with unlimited access to a computer, its programs, and its data could execute a fraud and at the same time conceal it. Therefore, effective segregation of duties should be instituted by separating the **authority** for and the **responsibility** for the function.

Although designing and implementing segregation of duties controls makes it difficult for one employee to commit fraud, remember that segregation of duties is not perfect insurance against fraud because two employees could collude to override the controls.

We will look at the various positions within a computer system and the responsibilities of each.

- **Systems analysts** are responsible for reviewing the current system to make sure that it is meeting the needs of the organization, and when it is not, they will provide the design specifications to the programmers of the new system. Systems analysts should not do programming, nor should they have access to hardware, software or data files.
- **Programmers** are the individuals who write, test and document the systems. They are able to modify programs, data files and controls, but should not have access to the computers and programs that are in actual use for processing. For instance, if a bank programmer were allowed access to actual live data and had borrowed money from the bank, he or she could delete their own loan balance while conducting a test. When programmers must do testing, they should work with **copies** of records only and should not have the authority, opportunity or ability to make any changes in master records or files.
- **Computer operators** perform the actual operation of the computers for processing the data. They should not have programming functions and should not be able to modify any programs. Their job responsibilities should be rotated so no one operator is always overseeing the running of the same application. **The most critical segregation of duties is between programmers and computer operators.**
- The **data control group** receives user input, logs it, monitors the processing of the data, reconciles input and output, distributes output to authorized users, and checks to see that errors are corrected. They also maintain registers of computer access codes and coordinate security controls with other computer personnel. They must keep the computer accounts and access authorizations current at all times. **They should be organizationally independent of computer operations.** Systems control personnel should be responsible for detecting and correcting errors, not computer operators.
- **Transaction authorization:** Users should submit a signed form with each batch of input data to verify that the data has been authorized and that the proper batch control totals have been prepared. Data control group personnel should verify the signatures and batch control totals before submitting the input for processing. This would prevent a payroll clerk, for instance, from submitting an unauthorized pay increase. Furthermore, no personnel in the Information Systems group should have authority to initiate or authorize any entries or transactions.
- **Data conversion operators** perform tasks of converting and transmitting data. They should have no access to the library or to program documentation, nor should they have any input/output control responsibilities.
- **Librarians** maintain the documentation, programs and data files. They should have no access to equipment. The librarian should restrict access to the data files and programs to authorized personnel at scheduled times. Furthermore, the librarian maintains records of all usage, and those records should be reviewed regularly by the data control group for evidence of unauthorized use.
- Only authorized people should be able to call program vendor technical support departments. If vendor-supplied systems are used, the vendors' technical support area should have a means of identifying callers and should give technical instructions for fixing problems only to employees who are authorized to receive such instructions.
- The **database administrator** controls access to various files, making program changes, and making source code details available only to those who need to know.
- The location of any off-site storage facilities should be known by as few people as possible.
- No IS personnel should have access to any assets that are accounted for in the computer system.

System and Program Development and Change Controls

Systems development controls during the development stage of an information system enhance the ultimate accuracy, validity, safety, security and adaptability of the new system's input, processing, output and storage functions.

Controls are instituted at this stage for multiple reasons.

- 1) To ensure that all changes are properly authorized and are not made by individuals who lack sufficient understanding of control procedures, proper approvals and the need for adequate testing.
- 2) To prevent errors in the resulting system that could cause major processing errors in data.
- 3) To limit the potential for a myriad of other problems during the development process and after its completion.

The following are only a few of the control considerations in systems development. This is not an exhaustive list but presented to give you an idea of what is involved. These have been adapted from the recommendations in COBIT.

1) Statement of Objectives Stage

- The authorized users should submit a written request, stating the business need. The request should be reviewed by the steering committee.
- The user department management should participate in the definition and authorization of the development, implementation, or modification project.
- There should be a clear written statement defining the nature and scope of the project.
- A risk assessment should be done as part of the initial proposal to document security threats, potential vulnerabilities and impacts, and the feasible security and internal control safeguards necessary to reduce or eliminate the identified risks.

If the request is approved, resources are allocated for the next stage, which will be the feasibility study.

A clear, written statement of objectives and a risk assessment at this stage can limit the number of changes needed later on and shorten the time required to identify solutions and get approvals later on.

2) Investigation and Feasibility Study Stage

- A cost-benefit analysis is done. Questions to be answered include whether the system will provide an adequate payback; whether it will fit into the existing software environment; whether it will run on existing hardware or whether a hardware upgrade will be needed; whether new storage media will be required; whether the resources are available for the project; whether the application would require extensive user or programmer training; and what effect it would have on existing systems.
- The feasibility study should include an analysis of needs, costs, implementation times, and potential risks.
- In evaluating possible solutions, criteria should be developed for consideration of in-house development, purchased solutions and outsourcing options.
- The technological feasibility of each alternative for satisfying the business requirements should be examined; and the costs and benefits associated with each alternative under consideration should be analyzed.
- Key users should be identified to assist in the analysis and recommendations.
- The development team should have a good knowledge of the solutions available and limit their consideration to proven technology rather than experimenting with new technology, unless experimentation is justified by the situation.

- Senior management should review the reports of the feasibility studies and approve or disapprove proceeding with the project.
- For each approved project, a master plan should be created to maintain control over the project throughout its life, which includes a method of monitoring the time and costs incurred.

The cost-benefit analysis done at this stage is extremely important as a control tool, as this can also reduce changes later on that could be caused by the discovery of unexpected costs. Furthermore, if the project is seriously flawed, it can be rejected at this stage before a major investment is made.

3) Systems Analysis Stage

- Business requirements satisfied by the existing system and those that the proposed system expects to attain should be clearly defined, including user requirements, specifications as to what the new system is supposed to accomplish, and alternatives for achieving the specifications such as in-house development versus a vendor package.
- Inputs, processing requirements and output requirements should be defined and documented.
- All security requirements should be identified at the requirements phase of the project and justified, agreed and documented.
- A structured analysis process should be used.

If the information required by the users is not clear, the new system cannot possibly support the business process, leading again to delays in implementation and additional costs to redesign the system.

4) Systems Design and Development Stage

- Systems analysts, working closely with system users, create the design specifications and verify them against the user requirements.
- System flowcharts, report layouts, data conversion procedures and test plans are developed.
- Design specifications should be reviewed and approved by management, the user departments and senior management.
- Detailed program specifications should be prepared to ensure that program specifications agree with system design specifications.
- Mechanisms for the collection and entry of data should be specified for the development project.
- Data elements are defined. Each field in each file is listed and defined.
- The file format should be defined and documented for the project to ensure that data dictionary rules are followed.
- All external and internal interfaces should be properly specified, designed and documented.
- An interface between the user and the machine that is easy to use and contains online help functions should be developed.
- Hardware and software selection should identify mandatory and optional requirements. The potential impact of new hardware and software on the performance of the overall system should be assessed.
- An up-to-date inventory of hardware and software infrastructure should be available.
- Acquisition policies and practices should be clearly understood, and the selection process should focus on using reusable components.
- Performance and capacity requirements should be duly considered.
- Key requirements should be prioritized in case of possible scope reductions.

- Adequate mechanisms for audit trails should be developed for the selected solution that provides the ability to protect sensitive data.
- Contracts with suppliers should include a definition of acceptance criteria and procedures, and dependency on single-source suppliers should be managed.
- If a vendor package or packages are to be used, they should be evaluated rigorously. Factors to consider include the stability of the vendor, how long the system has been on the market, whether it has a base of users and the satisfaction level of current users of the system, the vendor's quality control standards, the adequacy of the documentation, the availability of vendor technical support, and flexibility of the system such as whether it has a report writer that users can use to develop reports themselves. Also, what the system's processing speed will be on the organization's systems is a consideration.
- As already mentioned, only authorized people should be able to call vendor technical support departments. This is an important control, so it warrants mentioning again. The evaluation of a vendor system should include inquiries as to the means the vendor has to identify callers to its technical support area and determine whether the caller has authority to receive technical instructions for fixing problems.

The benefits from these controls should be reduction in delays due to inadequate infrastructure, reduced interoperability and integration problems, and reduced costs for modifications later.

5) Program Coding and Testing Stage

- Programs are coded according to the specifications developed in the systems design and development stage.
- Procedures should provide for a formal evaluation and approval by management of the user department(s) and management of the IT function of work accomplished and test results in each phase of the cycle before work on the next phase begins.
- There should be a separation between development and testing activities.
- A formal process for handover from development to testing to operations should be defined.
- Resources should be available for a separate testing environment, which reflects as closely as possible the live environment, and sufficient time should be allowed for the testing process.
- Parallel or pilot testing should be performed, and criteria for ending the testing process should be specified in advance.
- Testing should be done both of the individual application and of the application within the system.
- An independent group should do the testing and try to make the system fail.
- Both in-house systems and vendor packages should be tested.

Testing is the final check to make sure the system performs as it should.

6) Systems Implementation Stage

- An implementation plan should be prepared, reviewed and approved by relevant parties and also used to measure progress. It should include site preparation, equipment acquisition and installation, user training, installation of operating software changes and implementation of operating procedures and conversion procedures.
- Data conversion is done. Controls such as record counts, reviews of reports and other types of reconciliations are required.
- The degree and form of documentation required is agreed upon and followed in the implementation. Documentation will include **system documentation**, which is narrative descriptions, flowcharts, input and output forms, file and record layouts, controls, authorizations for any changes and backup procedures. It will also include **program documentation**, or descriptions of the programs, program flowcharts, program listings of source code, input and output forms, change requests, operator instructions and controls. **Operating documentation** is the information about the performance of the program. **Procedural documentation** provides information about the master plan and the handling of files, and **user documentation** includes all the information a user will need to be able to use the program.
- Documentation provides a basis for effective operation, use, audit and future system enhancements. It communicates among people who are developing, implementing and maintaining a system. A detailed record of the system's design is necessary in order to install, operate or modify an application. It is also needed for diagnosing and correcting programming errors; and it provides a basis for reconstruction of the system in case of damage or destruction.
- Standard operating procedures should be documented, distributed, and maintained using knowledge management, workflow techniques and automated tools.
- Staff of the user departments and the operations group of the IT function should be trained in accordance with the training plan.
- Formal evaluation and approval of the test results and the level of security for the system by management of the user department and the IT function should cover all components of the information system.
- Before the system is put into operation, the user should validate its operation as a complete product under conditions similar to the application environment.
- The decision should be made as to whether the new system will be implemented using a parallel conversion (running both the old and the new systems together for a period of time), a phased conversion (converting only parts of the application at a time or only a few locations at a time), pilot conversion (the new system is tested in just one work site before full implementation), or a direct conversion (changing over immediately from the old system to the new).

The benefits of these controls are more seamless integration of the new system into existing business processes, adequate documentation at a reduced cost, and greater user proficiency and satisfaction with the training process.

7) Systems Evaluation and Maintenance Stage

- After implementation, the system moves into the maintenance phase.
- A process should be in place to manage coordination between and among changes, recognizing interdependencies.
- There should be segregation of duties between development and production.
- Maintenance personnel should have specific assignments, their work should be monitored, and their system access rights should be controlled.

- There should be a post-implementation review to assess whether the users' needs are being met by the system.
- Any modifications to the system should be authorized by user management, made in accordance with the same standards as are used for system development, and should be tested and approved by the user and IS management. Major projects should be approved by senior management.
- When changes are being tested, they should be tested not only by using correct information, but also by using incorrect information to make sure that the program will detect any errors and has the necessary controls.
- Whenever system changes are implemented, associated documentation and procedures should be updated accordingly.
- For a vendor package, maintenance procedures are of concern from a systems control standpoint. Updates released by the vendor should be installed on a timely basis. For an organization with integrated software, releases must be kept compatible. If one portion of the system is upgraded and another part is not, the two systems may no longer interface properly.
- If vendor-supplied software has had custom changes made to the vendor's source code and the changes are not properly reinstalled on top of new releases, erroneous processing can result. The organization should maintain change controls to verify that all custom changes are properly identified. A good audit trail of all program changes is necessary. Another concern with vendor update releases when in-house changes have been made is that the changes may need to be not only reinstalled, but completely rewritten. The changes made to the prior release of the program might not work properly with the vendor's new release.
- Heavy modification of vendor code with no intention of installing new vendor releases because of the necessity to reinstall the modifications should be avoided, because the system becomes essentially an in-house system without the benefit of vendor support.

The benefits of these control procedures are reduced errors and disruptions due to poorly managed changes, reduced resources and time required for changes, and reduced number of emergency fixes.

Another thing to be aware of is that programs are written in **source code**, which is the language that the programmer uses for coding the program, and they also exist in **object code**, which is the machine language that the processor can understand. The source code file is converted to object code by means of a program called a **compiler**, and the object code, not the source code, is what actually runs on the computer. This is important because **although in theory the source code and the object code should correspond, the computer does not require them to correspond**. It would be possible for a knowledgeable person to make a copy of the source code, rewrite portions of the instructions, compile the modified source code into a new object code file for use by the computer, and then destroy the modified source code file, leaving the authorized source code file unchanged. The result is that the executable object code – the actual instructions used by the computer – will not match the authorized source code. This is a weakness that can be used to commit computer fraud, if controls over compiling and cataloging activities are not adequate. Despite the strongest internal controls over day-to-day operations in user departments, a fraudulent change to a program could divert company funds to an individual, and the fraud could continue for a time without being detected.

Question 200: Program documentation is a control designed primarily to ensure that:

- a) Programmers have access to the tape library or information on disk files.
- b) Programs are kept up-to-date and perform as intended.
- c) Programs do not make mathematical errors.
- d) Data has been entered and processed.

(CMA Adapted)

Question 201: The reporting of accounting information plays a central role in the regulation of business operations. The importance of sound internal control practices is underscored by the Foreign Corrupt Practices Act of 1977, which requires publicly-owned U.S. corporations to maintain systems of internal control that meet certain minimum standards. Preventive controls are an integral part of virtually all accounting processing systems, and much of the information generated by the accounting system is used for preventive control purposes. Which one of the following is not an essential element of a sound preventive control system?

- a) Documentation of policies and procedures.
- b) Implementation of state-of-the-art software and hardware.
- c) Separation of responsibilities for the recording, custodial and authorization functions.
- d) Sound personnel practices.

(CMA Adapted)

Question 202: The process of learning how the current system functions, determining the needs of users and developing the logical requirements of a proposed system is referred to as:

- a) Systems analysis.
- b) Systems feasibility study.
- c) Systems implementation.
- d) Systems maintenance.

(CMA Adapted)

Question 203: The most critical aspect of separation of duties within information systems is between:

- a) Programmers and computer operators.
- b) Programmers and project leaders.
- c) Programmers and systems analysts.
- d) Systems analysts and users.

(CMA adapted)

Physical Access Controls

Computer facility controls should be in place to protect the physical assets of the computer center: the hardware, peripherals, documentation, programs and data files in the library. The computer processing center should be in a locked area, and access to it should be restricted to authorized persons. Some means of accomplishing this are:

- Have company personnel wear color-coded ID badges with photos. People authorized to enter the computer area are assigned an ID badge of a particular color.
- With magnetic ID cards, each employee's entry into and exit from the computer center can be automatically logged.
- The door can be kept locked, and a person can enter only if "buzzed" in by the control person, who permits only authorized people to enter.
- Keys may be issued to authorized personnel, or combination locks can be used to limit access. If keys are used, they should be keys that cannot be easily duplicated, and locks need to be changed periodically. If a combination lock is used, the combination should be changed periodically.
- The location of the computer center should also be in a place where it is protected from natural disasters as much as possible.
- The computer center should be equipped with smoke and water detectors, fire suppression devices, burglar alarms and surveillance cameras monitored by security personnel.
- Insurance is the last resort, to be called upon only if all else fails, because it does not actually protect from loss but rather compensates for loss after it occurs. Insurance policies for computer damages are usually restricted to actual monetary losses suffered, which is difficult to assess. For example, computers may have a market value that is far less than the value of their services to the company.

Hardware Controls for Networks

Computer networks require special controls due to the decentralized nature of the hardware.

- 1) **Checkpoint processing** should be used to enable recovery in case of a system failure. Checkpoint control procedures are performed several times per hour, and during that time, the network system will not accept posting. It stops and backs up all the data and other information needed to restart the system. This **checkpoint** is recorded on separate media. Then, if a hardware failure occurs, the company simply reverts to the last saved copy, and reprocesses only the transactions that were posted after that checkpoint. The effect of this is similar to the **rollback and recovery method**.
- 2) **Routing verification procedures** protect against transactions routed to the wrong computer network system address. Any transaction transmitted over the network must have a header label identifying its destination. Before sending the transaction, the system verifies that the destination is valid and authorized to receive data. After the transaction has been received, the system verifies that the message went to the destination code in the header.
- 3) **Message acknowledgment procedures** can prevent the loss of part or all of a transaction or message on a network. Messages are given a trailer label, which the receiving destination checks to verify that the complete message was received.

Question 204: Most of today's computer systems have hardware controls that are built in by the computer manufacturer. Common hardware controls are:

- a) Duplicate circuitry, echo check and internal header labels.
- b) Duplicate circuitry, echo check and dual reading.
- c) Tape file protection, cryptographic protection and limit checks.
- d) Duplicate circuitry, echo check, tape file protection and internal header labels.

(CMA Adapted)

File Security and Storage Controls

File Security Control procedures include:

- **Labeling the contents** of discs (CDs, DVDs, external hard drives, etc.), tapes, flash drives or memory cards, and any other removable media, both externally and internally as part of the data file.
- The **read-only** file designation is used to prevent users from altering or writing over data.
- **Database Management Systems** use **lockout procedures** to prevent two applications from updating the same record or data item at the same time.

Note: A **deadly embrace** occurs when two different applications or transactions each have a lock on data that is needed by the other application or transaction. Neither process is able to proceed, because each is waiting for the other to do something. In these cases the system must have a method of determining which transaction goes first, and then it must let the second transaction be completed using the updated information after the first transaction.

- The librarian's function is particularly critical, because documentation, programs and data files are assets of the organization and require protection the same as any other asset would. The data files contain information that is critical to the enterprise, such as accounting records. Although backup procedures could reconstruct lost or damaged data, it is less costly to prevent a data loss than to repair it. Furthermore, confidential information is contained in the data files and must be protected from misuse by unauthorized individuals.
- Protection of program documentation is critical. Data can be changed within a file by someone who knows how to do it; and technical manuals containing file descriptions are one way to get the necessary information. Only authorized people who have the responsibility to repair data files that may become corrupt should have access to technical manuals.

Application Controls

Application controls focus on preventing, detecting and correcting errors in transactions as they flow through the **input**, **processing** and **output** stages of work in an information system. Here are some things that can go wrong and that adequate controls can prevent, detect and correct:

- Input loss can occur when transaction information is transmitted from one location to another.
- Input duplication can occur if an input item is thought to be lost and is recreated, but the original item is subsequently found or was never actually lost.
- Inaccurate input in the form of typographical errors in numbers or in spelling.
- Missing information makes the input incomplete.
- Unrecorded transactions can occur as accidental failures or can be the result of theft or embezzlement.
- In a volume processing environment, management authorization of every individual transaction may not take place, allowing improper transactions to slip through.
- Automated transactions may be set up for regular orders or payments to suppliers. However, unusual situations can call for special transactions, and automated transactions can cause problems.
- Output can be sent to the wrong people, or may be sent too late to be used.
- Programming errors or clerical errors can result in incomplete processing.
- Processing may be delayed.
- Files can be lost during processing.
- Poor documentation and a loss of knowledgeable people can result in errors and omissions.

Application controls are divided into **input** controls, **processing** controls and **output** controls.

Input Controls

Input controls are the controls designed to provide reasonable assurance that data entered into the system has proper authorization, has been converted to machine-sensible form and has been entered accurately. Input controls can also provide some assurance that data (including data sent over communications lines) has not been lost, suppressed, added or changed in some manner.

Input is the stage where there is the most human involvement and, as a result, the risk of errors is higher than in the processing and output stages. **Most errors in systems are the result of input errors.** If information is not entered correctly, there is no chance that the output will be correct. Processing might be done perfectly, but if the input into the system is inaccurate or incomplete, the output will be useless. Effective input controls are vital.

There are three classifications of input controls:

- Data observation and recording
- Data transcription
- Edit tests

Data Observation and Recording

One or more observational control procedures may be practiced:

- 1) **Feedback mechanisms** are manual systems that attest to the accuracy of a document. For instance, a sales person might ask a customer to confirm their order with a signature, attesting to the accuracy of the data in the sales order. Feedback mechanisms include **authorization, endorsement and cancellation**.
- 2) **Dual observation** means more than one employee sees the input documents. In some cases this might mean a supervisor reviews and **approves** the work.
- 3) **Point-of-sale devices** used to encode data can decrease errors substantially. In addition, point-of-sale devices eliminate the need to manually convert the data to machine-readable format.
- 4) **Preprinted forms** such as receipt and confirmation forms can ensure that all the data required for processing has been captured. For example, if a form utilizes boxes for each character in an inventory part number, it is more likely that the correct number of characters will be entered.
- 5) **Batch controls** should be used in the input phase to track data as it travels from place to place before it reaches the computer, to make sure no data is lost.
- 6) Batch controls do not work well with real-time systems, because data is entered at remote terminals sporadically and by different people. Transactions cannot be easily batched. However, entries can and should be displayed on a screen for visual verification and checked against backup data. Furthermore, information input can be checked against the database, and edit programs can be used to make sure that each field has the proper format (see following topics).
- 7) Transaction trails should be created by the system that show the date, terminal ID, and individual responsible for the input. This is particularly important in a real-time system. All inputs are logged to a special file that contains these identifying **tags** to identify the transactions. Including this additional, audit-oriented information along with original transaction data is called **tagging**.
- 8) Transaction logs also provide a source of **control totals**.

Data Transcription

Data transcription is the preparation of the data for processing. If data is entered from source documents, the source documents should be organized in a way that eases the input process.

The actual data input usually takes place at a workstation with a display terminal. A **preformatted input screen** can assist in the transcription process. For example, a date field to be filled in would be presented onscreen as / / .

Format checks are used to verify that data is entered in the proper mode: numeric data in a numeric field, a date in a date field, etc.

Edit Tests

Edit programs or input validation routines are programs that check the validity and accuracy of input data. They perform **edit tests** by examining specific fields of data and rejecting transactions if their data fields do not meet data quality standards. Edit tests include:

- **Completeness, or field, checks**, which ensure that data is input into all required fields and that the data is in the proper format. For example, a field check would not permit numbers to be input into a field for a person's name.
- **Limit checks**, which ensure that only data within predefined limits will be accepted by the system. For example, the number of days worked in a week cannot exceed 7.
- **Validity checks**, which match the input data to an acceptable set of values or match the characteristics of input data to an acceptable set of characteristics.

- **Overflow checks**, which make sure that the number of digits entered in a field is not greater than the capacity of the field.
- **Check digits**, which determine whether a number has been transcribed properly. A check digit is a number that is a part of an account or other type of number. The check digit is a function of the other digits within the number, determined by a mathematical algorithm. If a digit in the account number is keyed in incorrectly, the check digit will be incorrect, and the system will generate an error message and refuse to accept the input. Check digits are commonly used in credit card account and bank account numbers, and they are especially helpful in detecting transposition errors. If an operator keys in a number incorrectly, the operator will get an error message such as "invalid account number."
- **Key verification, or keystroke verification**, is the process of inputting the information again and comparing the two results. Key verification is often used when changing a password, to confirm that the password has been typed correctly. Key verification can also be used to require input of the same information twice by different people.
- **Hash totals** are totals of nonmonetary information. A hash total can be run on a group of records to be input before processing or transmission and again after processing. If a hash total changes during processing, it indicates something has changed or may be lost.
- **Format checks** check whether the data has been entered in the proper mode and within the proper fields.
- **Reasonableness checks** compare input with other information in existing records and historical information to detect data that is not reasonable.
- **Numerical checks** assure that numeric fields are used only for numeric data.
- **Overflow checks** can prevent input that would exceed the capacity of a memory or field length.
- **Reconciliations and balancing**. Reconciliations are used to determine whether differences exist between two amounts that should be equal. If there are differences, the differences are analyzed to detect the reason, and corrections can be made if necessary.

Corrections of errors present additional problems. Often, attempts to correct an error result in additional errors. Error reports need to be analyzed, the action required to make the correction needs to be determined, the incorrect data needs to be reversed and correct data needs to be input. Often, corrections are needed in multiple data files.

Inquiries of data or master files need to be designed so there is no possibility of the inquiry changing the information in the file.

Question 205: The online data entry control called preformatting is:

- a) A check to determine if all data items for a transaction have been entered by the terminal operator.
- b) A program initiated prior to regular input to discover errors in data before entry so that the errors can be corrected.
- c) The display of a document with blanks for data items to be entered by the terminal operator.
- d) A series of requests for required input data that requires an acceptable response to each request before a subsequent request is made.

(CMA Adapted)

Question 206: Routines that use the computer to check the validity and accuracy of transaction data during input are called:

- a) Operating systems.
- b) Compiler programs.
- c) Edit programs.
- d) Integrated test facilities.

(CMA Adapted)

Processing Controls

Processing controls are controls designed to provide reasonable assurance that processing has occurred properly and that no transactions have been lost or incorrectly added. Processing controls prevent or discourage the improper manipulation of data and ensure satisfactory operation of hardware and software.

Processing controls include the physical security of the equipment. At one time, processing controls were limited to the computer room. But with more and more distributed processing taking place, these controls are moving outside the room where the computer equipment is located.

Access to the computer should be permitted only to people who are authorized to operate the equipment, and operators should be given access only to information they need to set up and operate the equipment.

Processing controls fall into two classifications:

- Processing controls at the time of data access, and
- Controls involving data manipulation later in the processing.

Data Access Controls

Transmittal documents such as batch control tickets are used to control movement of data from the source to the processing point or from one processing point to another. **Batch sequence numbers** are used to number batches consecutively to make sure all batches are accounted for.

Batch control totals were mentioned as input controls, but they are also processing controls. Batch control totals are any type of control total or count applied to a specific group of transactions, such as total sales dollars in a batch of billings. Batch control totals are used to ensure that all input is processed correctly by the computer. In batch processing, items are batched in bundles of a preset number of transactions. If a batch consists of **financial** transactions, a **batch control document** that goes with the batch includes the bundle number, the date and the total dollar amount of the batch. As the computer processes the batch, it checks the **batch control total** (the total dollar amount) for the batch and compares the processed total with the batch control total. If they match, the batch is posted. If they do not, the posting is rejected, and the difference must be investigated. Batch control totals can also be calculated and used for **non-financial** fields in transactions. For instance, a batch control total might be the total hours worked by employees.

A **hash total** is another control that is both an input and a processing control. For instance, if a batch contains data on receipts from accounts receivable customers, the sum of all the customers' account numbers might be computed to create a **hash total**. This sum is useful only for control purposes, and it is compared with the total computed during processing to make sure nothing was lost or altered during processing.

A **record count** utilizes the number of transaction items and counts them twice, once when preparing the transactions in a batch and again when performing the processing.

Data Manipulation Controls

Standard procedures should be developed and used for all processing.

Examining **software documentation**, such as **system flowcharts**, **program flowcharts**, **data flow diagrams** and **decision tables**, can also be a control, because it makes sure that the programs are complete in their data manipulation.

Computer programs are error tested by using a **compiler**, which checks for programming language errors.

Test data can be used to test a computer program.

System testing can be used to test the interaction of several different computer programs. Output from one program is often input to another, and system testing tests the linkages between the programs.

There are a number of other tests of processing, such as:

- **Batch balancing** is comparing the items actually processed against a predetermined control total.
- **Cross-footing** compares the sum of the individual components to a total.
- A **zero-balance check** is used when a sum should be zero. All of the numbers are added together and the total is compared with zero.
- **Run-to-run totals** are output control totals from one process used as input control totals over subsequent processing. Critical information is checked to ensure that it is correct. The run-to-run totals tie one process to another.
- **Default option** is the automatic use of a predefined value when a certain value is left blank in input. However, a default option may be correct, or it may be an incorrect value for a particular transaction, so the default should not be automatically accepted.

Question 207: In an automated payroll processing environment, a department manager substituted the time card for a terminated employee with a time card for a fictitious employee. The fictitious employee had the same pay rate and hours worked as the terminated employee. The best control technique to detect this action using employee identification numbers would be a:

- a) Hash total.
- b) Batch total.
- c) Subsequent check.
- d) Record count.

(CMA Adapted)

Question 208: Data input validation routines include:

- a) Passwords.
- b) Terminal logs.
- c) Backup controls.
- d) Hash totals.

(CMA Adapted)

Output Controls

Output can consist of account listings, displays, reports, files, invoices, or disbursement checks, to name just a few of the forms output can take. Output controls are used to provide reasonable assurance that input and processing has resulted in valid output. Controls should be in place to make sure that the output is sent to the right people, that it is accurate and complete, it is sent in a timely manner, and that the proper reports are retained for the appropriate time period.

The output of the system is supervised by the **data control group**. Output control consists of:

- Validating processing results, and
- Controls over printed output.

Validating Processing Results

Activity, or proof, listings that document processing activity provide detailed information about all changes to master files and create an audit trail. These proof listings should be compared with the batch control totals that went along with the input and processing functions in order to confirm that all of the transactions were processed correctly.

Reconciliations are the analysis of differences between values in two files that should be substantially the same. The nature of the reconciling items is used to identify whether differences are caused by errors or whether they are valid differences.

A **suspense account** is used as a control total for items awaiting further processing, such as a file of back-ordered products awaiting receipt so they can be shipped to fulfill orders.

Output control also includes review of the error logs by the control group and review of the output by the users. End-of-job markers are printed at the end of the report and enable the user to easily determine if the entire report has been received. A **discrepancy report** is a listing of items that have violated some detective control and need to be investigated, such as a list of all past-due accounts that is sent to the credit manager.

Upstream resubmission is the resubmission of corrected error transactions as if they were new transactions, so that they pass through all the same detective controls as the original transaction.

Printed Output Controls

Forms control, such as physical control over company checks, is one type of printed output controls. Checks should be kept under lock and key, and only authorized persons should be permitted access.

However, there is another control needed with checks, because they are **prenumbered**. **The preprinted check number on the form must match the computer-generated number that is also printed on the check.** The preprinted numbers on the checks are sequential; the computer-generated numbers also are sequential. The starting computer-generated number must match the first check in the stack, or the numbers in the whole check run will be off. If there is any discrepancy, it must be investigated because the starting number in the computer **should be one more than the last check printed**. If it does not match the preprinted number on the check stock, one or more checks could be missing.

Any form should be **prenumbered** and controlled in the same manner as checks.

Companies are increasingly creating their own checks, using blank check stock and printers that print all of their information as well as the MICR (Magnetic Ink Character Recognition) line as the check itself is printed. The physical equipment used to create checks as well as the blank check stock must be strictly controlled.

Output control also concerns report distribution. For example, a payroll register with all the employees' social security numbers and pay rates is confidential information and thus its distribution must be restricted. There should be an **authorized distribution list**, and only enough copies of the report to permit one report to be distributed to each person on the list should be processed. For a confidential report, it is preferable to have a representative pick the report up personally and sign for it. If this is not possible, a bonded employee can be used to hand deliver the reports. The employee's supervisor should make random checks on this distribution.

Confidential reports should be **shredded** when they are no longer needed.

Controls Classified as Preventive, Detective and Corrective

Just as financial controls can be classified as **preventive**, **detective** and **corrective**, information systems controls can be classified in the same manner.

- **Preventive controls** prevent errors and fraud before they occur. Examples of **preventive** controls are segregation of duties, job rotation, training and competence of personnel, dual access controls, authorization, approval, endorsement and cancellation, and preformatted input.
- **Detective controls** uncover errors and fraud after they have occurred. Examples of **detective** controls are transmittal documents, batch control totals and other batch transmittal documents, completeness checks, hash totals, batch balancing, check digits, limit checks, and validity checks. The use of a **turnaround document** is also a detective control, because it checks on completeness of input. Completeness of processing detective controls include run-to-run totals, reconciliations, use of suspense accounts, and error logs. Correctness of processing detective controls are redundant processing, overflow checks and summary processing.
- **Corrective controls** are used to correct errors. Examples of **corrective** controls are discrepancy reports and upstream resubmissions.

Question 209: An advantage of having a computer maintain an automated error log in conjunction with computer edit programs is that:

- a) Less manual work is required to determine how to correct errors.
- b) Better editing techniques will result.
- c) The audit trail is maintained.
- d) Reports can be developed that summarize the errors by type, cause and person responsible.

(CMA Adapted)

Question 210: An employee in the receiving department keyed in a shipment from a remote terminal and inadvertently omitted the purchase order number. The best systems control to detect this error would be:

- a) Completeness test.
- b) Batch total.
- c) Reasonableness test.
- d) Sequence check.

(CMA Adapted)

Question 211: Preventive controls are:

- a) Usually more cost beneficial than detective controls.
- b) Usually more costly to use than detective controls.
- c) Found only in accounting transaction controls.
- d) Found only in general accounting controls.

(CMA Adapted)

Question 212: Edit checks in a computerized accounting system:

- a) Are preventive controls.
- b) Must be installed for the system to be operational.
- c) Should be performed on transactions prior to updating a master file.
- d) Should be performed immediately prior to output distribution.

(CMA Adapted)

Internet Security

Once a company is connected to an outside network (usually the Internet), there are a number of additional security issues that must be properly addressed. The company must make sure that the policies that it puts in place allow the intended and authorized users to have access to the network as needed. However, accessibility also creates vulnerability.

Electronic eavesdropping can occur if computer users are able to observe transmissions intended for someone else. Therefore, organizations must ensure that information sent over a network is properly protected to maintain the confidentiality of company information. Furthermore, the company must ensure that company files cannot be accessed or changed without authorization.

At a minimum, the system should include **user account management**, a **firewall**, **anti-virus** protection and **encryption**.

- **User account management** is the simple process of giving people accounts and passwords. In order for this to be as effective as possible, the company must keep these up-to-date. Inactive accounts should be eliminated and active passwords changed frequently.
- A **firewall** serves as a barrier between the internal and the external networks and prevents unauthorized access to the internal network. A properly configured firewall makes a computer's ports invisible to port scans. In addition to protecting a computer from incoming probes, a firewall can also prevent backdoor applications, Trojan horses and other unwanted applications from sending data from the computer. Most firewalls will usually prepare a report of Internet usage, including any abnormal or excessive usage and attempts to gain unauthorized entry to the network. A firewall can be in the form of software directly installed on a computer, or it can be a piece of hardware that is installed between the computer and its connection to the Internet.
- **Antivirus software**, regularly updated with the latest virus definitions, is the best defense against viruses, Trojan horses and worms. Antivirus software recognizes and incapacitates viruses before they can do damage. You must keep your antivirus software up-to-date, however, because new viruses appear constantly. Programs that specifically defend against Trojan horses are also available.
- **Encryption** is the best protection against traffic interception resulting in data leaks. **Encryption** converts data into a code and then a key is required to convert the code back to data. Unauthorized people can receive the coded information, but without the proper key, cannot read it. Thus, an attacker may be able to see where the traffic came from and where it went, but not the content.

Viruses, Trojan Horses and Worms

A **computer virus** is a program that alters the way another computer operates. Viruses can damage programs, delete files or reformat the hard disk. Other viruses do not do damage but replicate themselves and present text, video and audio messages. Although these viruses may not cause damage directly, they create problems by taking up computer memory and causing erratic behavior or system crashes that can lead to data loss. To be considered a virus, a virus must meet two criteria:

- 1) It must execute itself. A virus often places its own code in the path of the execution of another program.
- 2) It must replicate itself. A virus can replace other executable files with a copy of the virus-infected file.

A virus can be received from an infected disk, a downloaded file, or an email attachment, among other places.

A **Trojan horse** is different from a virus. A very important distinction between Trojan horses and viruses is that Trojan horses **do not replicate themselves**, whereas viruses do. The purpose of a Trojan horse is not to spread like a virus, but to have a particular target — a particular computer — on which to run a program. A strict definition of a Trojan horse is, "any program that does something besides what a person believes it will do." A Trojan horse can appear to be something desirable, but in fact it contains malicious code that, when triggered, will cause loss or even theft of data. A typical example of a Trojan horse is a program hidden inside of a humorous animation that opens a back door into the system. Another example of a Trojan horse is commercial software that collects data on the person running the program and sends it back to the originating company without warning the target.

You can get a Trojan horse only by inviting it into your computer. Two examples are by:

- 1) Opening an e-mail attachment or
- 2) Downloading and running a file from the Internet. Many mass-mailing worms are considered Trojan horses because they must convince someone to open them. The SubSeven server, which is software that lets an attacker remotely control any computer it is installed on, is an example of a program typically embedded in a Trojan horse.

A **worm** is a program that replicates itself from system to system without the use of any host file. The difference between a worm and a virus is that the worm does not require the use of an infected host file, while the virus does require the spreading of an infected host file. Worms generally exist inside of other files, often Word or Excel documents. However, worms use the host file differently from viruses. Usually the worm releases a document that has the "worm" macro inside the document. The entire document spreads from computer to computer, so the entire document is, in essence, the worm.

A **virus hoax** is an e-mail telling you that a file on your computer is a virus when it isn't. These e-mails often tell you to look on your system for a file with a specific name and, if you see it, delete it because the file contains a virus that is unrecognizable by your anti-virus program. Everyone will find that file, because it is a system file that is needed for the computer to operate correctly. If you believe this e-mail and delete the file, your computer may malfunction.

Note: The difference between a virus and a Trojan is that a virus replicates itself, but a Trojan does not.

The difference between a virus and a worm is that the virus requires an infected host file in order to replicate itself, while the worm can replicate itself without a host file.

Question 213: An organization installed antivirus software on all its personal computers. The software was designed to prevent initial infections, stop replication attempts, detect infections after their occurrence, mark affected system components and remove viruses from infected components. This major risk in relying on antivirus software is that antivirus software may:

- a) Not detect certain viruses.
- b) Make software installation overly complex.
- c) Interfere with system operations.
- d) Consume too many system resources.

(CIA Adapted)

Question 214: The primary objective of security software is to:

- a) Control access to information system resources.
- b) Restrict access to prevent installation of unauthorized utility software.
- c) Detect the presence of viruses.
- d) Monitor the separation of duties within the applications.

(CIA Adapted)

Cybercrime

The Internet, online communications and e-business are all subject to computer crime and this threat is growing every day.

A very broad definition of computer crime according to the FBI National Computer Crime Squad (NCCS) is "crimes where the computer is a major factor in committing the criminal offense." The NCCS investigates violations of the Federal Computer Fraud and Abuse Act (CFAA) and is concerned with all computer crimes that cross multiple state or international boundaries. CFAA was intended to control interstate computer crime and since the advent of the Internet, almost all computer use has become interstate and international in scope.

The NCCS explicitly lists the following as the most serious computer crimes:

- Intrusions of the Public Switched Network (the telephone company),
- Major computer network intrusions,
- Network integrity violations,
- Privacy violations,
- Industrial espionage, and
- Pirated computer software.

The Association of Information Technology Professionals (AITP) defines computer crime as:

- The unauthorized use, access, modification or destruction of hardware, software, data or network,
- The unauthorized release of information,
- The unauthorized copying of software,
- Denying an end user access to his or her own hardware, software, data or network resources or
- Using or conspiring to use computer or network resources to illegally obtain information or tangible property.

Some specific computer crimes include:

- **Copyright infringement** such as the illegal copying of copyrighted material, whether intellectual property, such as computer programs or this textbook, or entertainment property such as music and movies,
- **Denial of Service (DOS)** attacks in which a website is accessed repeatedly so that other, legitimate users cannot connect to it,
- **Theft of credit card numbers** from retailers' files,
- **Phishing**, a high-tech scam that uses spam e-mail to deceive consumers into disclosing their credit card numbers, bank account information, Social Security numbers, passwords or other sensitive personal information, and
- Installation of **malware** on a computer without the user's knowledge. An example of malware is a keylogger that records every keystroke and sends it back to the hacker. Keylogging software has been used to gather bank information, credit card information, and passwords. Other malware turns a PC into a "zombie," giving hackers full control over the machine. Hackers set up "botnets" — networks consisting of millions of zombies — that can be made to each send out tens of thousands of spam emails or emails infected with viruses, and the computer users don't even know it is happening.

Using **port scans**, hackers can look for a particular make of computer or a particular software program, because they know of weaknesses in those computers or programs that they can exploit. Once a hacker has identified a vulnerable computer or software application, they can leave a **back door** open in the computer in order to re-enter it at any time. If the original entry point is detected and closed, the back door functions as a hidden, undetected way back in.

A **sniffer** is a piece of software that grabs all of the traffic flowing into and out of a computer attached to a network. Sniffers have legitimate as well as illegitimate uses. Intrusion Detection Systems (IDS) use sniffers to match packets against a rule set designed to flag things that appear malicious or strange. Network utilization and monitoring programs often use sniffers to gather data necessary for metrics and analysis.

Most personal computers are on Local Area Networks (LANs), meaning they share a connection with several other computers. If a network is not **switched** (a switch is a device that filters and forwards packets between segments of the LAN), traffic intended for any machine on a segment of the network is broadcast to every machine on that segment. This means that every computer actually sees the data traveling to and from each of its neighbors, but normally ignores it. The **sniffer** program tells a computer to stop ignoring all the traffic headed to other computers and instead pay attention to that traffic. The program then begins a constant read of all information entering the computer.

Anything transmitted in plain text over the network is vulnerable to a sniffer — passwords, web pages, database queries and messaging, to name a few. Once traffic has been captured, hackers can quickly extract the information they need. The users will never know their information has been compromised, because sniffers cause no damage or disturbance to the network environment.

Other tools of hackers include:

- **Password crackers**, which is software that creates different combinations of letters and numbers in order to guess passwords;
- **War dialing** or programs that automatically dial random telephone numbers in search of a modem connection;
- **Logic bombs** or errors in the logic of computer programs that result in the destruction of computer data or a malicious attack when specific criteria are met; and
- **Buffer overflow**, which sends too much data to the buffer in a computer's memory, crashing it or enabling the hacker to gain control over it.

Some computer crime tactics involve efforts in person as well as computer activities. Tactics involving personal effort include social engineering and dumpster diving. **Social engineering** involves calling up company employees and deceiving them into divulging information such as passwords. **Dumpster diving** is sifting through a company's trash for information that can be used either to break into its computers directly or to assist in social engineering.

Another online scam is directed against companies that advertise on search engines on a "pay-per-click" basis. Google is probably the best-known example of a search site that charges advertisers each time a visitor clicks on the ad links. In one version of this scam, a competitor will write a software program that repeatedly clicks on a business's ads in order to run up its advertising charges. Ultimately, after too many clicks within a 24-hour period, the ad is pushed off the search engine site, resulting in lost business for the company along with the inflated advertising fees.

However, it is not only outsiders who commit computer crimes against a company. Insiders — or company employees — are a primary source of trouble. Employees who are planning to leave one employer and go to work for a competitor can use their company e-mail to transmit confidential information from the current employer to the future employer.

Insider crime can also include using the company computer for private consulting, personal financial business, playing video games on company time or browsing pornography sites. A legitimate use of **sniffers**, described earlier, is monitoring network usage to reveal evidence of improper use. Some businesses install software that enables them not only to monitor their employees' access to websites but also to block access to certain websites. Improper use of the Internet and e-mail at work can get an employee fired immediately.

Defenses Against Cybercrime

As we said earlier, the best defense against port scans is a good **firewall**. A firewall serves as a barrier between the internal and the external networks and prevents unauthorized access to the internal network. A properly configured firewall makes a computer's ports invisible to port scans. In addition to protecting a computer from incoming probes, a firewall can also prevent backdoor applications, Trojan horses and other unwanted applications from sending data from the computer. Most firewalls will usually prepare a report of Internet usage, including any abnormal or excessive usage and attempts to gain unauthorized entry to the network. A firewall can be in the form of software directly installed on a computer, or it can be a piece of hardware that is installed between the computer and its connection to the Internet.

An organization may also use a **proxy server**, which is a computer and software that creates a gateway to and from the Internet. The proxy server contains an access control list of approved web sites and handles all web access requests, limiting access to only those sites contained in the access control list. This enables an employer to deny its employees access to sites that are unlikely to have any productive benefits. The proxy server also examines all incoming requests for information and tests them for authenticity. In this way, a proxy server functions as a firewall. The proxy server can also limit the information that is stored on it to information that the company can afford to lose. Thus, if this server is broken into, the organization's main servers remain functional.

Tools called **antisniffers** are available to defend against sniffers. When a sniffer program is active on a computer, the computer's network interface card (NIC) is placed in a state called **promiscuous mode**. The antisniffer scans networks to determine if any network interface cards are running in promiscuous mode. Antisniffers can be run regularly to detect evidence of a sniffer on the network. A **switched network** is also a deterrent, because it eliminates the broadcasting of traffic to every machine, although there are programs that a hacker can use to get around the switched network.

The best defense against phishing is in the hands of the recipient. Recipients need to know not to respond to any e-mail that requests personal or financial information and not to click on any link given in such an e-mail that could take them to a spoofed website. Similarly, recipients of unexpected e-mail attachments need to know not to open them, even if a virus scan has not identified any virus in the attachment. New viruses appear every day and one could slip past an antivirus program, even one that is updated regularly. Thus, employee education is a vital part of Internet security.

Encryption

Also as mentioned earlier, encryption is the best protection against traffic interception resulting in data leaks. **Encryption** converts data into a code and then a key is required to convert the code back to data. Unauthorized people can receive the coded information, but without the proper key, cannot read it. Thus, an attacker may be able to see where the traffic came from and where it went, but not the content.

The encryption process can be either in the hardware or in the software. There are two methods of software encryption: **secret key** and **public key/private key**.

- In a **secret key system**, each sender and recipient pair has a single key that is used to encrypt and decrypt the messages. The disadvantage to this method is that every pair of senders and receivers must have a separate set of keys that match. If several pairs all used the same set, then anyone having the key could decrypt anyone else's message and it wouldn't be a secret. This is impractical over the Internet, because any one company could have thousands of potential customers as well as others from whom it would need to receive messages.
- The **public key/private key encryption system** is a better system for companies to use. In a public-key/private-key encryption system, each entity that needs to receive encrypted data publishes a public key for encrypting data while keeping a private key to itself as the only means for decrypting that data. Anyone can encrypt and send data to the company using its published public key, but *only the company's private key can be used to decrypt the data* and only the company that published the public key has the private key.

A company obtains a public key and the private key to go with it by applying to a Certificate Authority, which validates the company's identity and then issues a certificate and unique public and private keys. The certificate is used to identify a company, an employee or a server within a company. The certificate includes the name of the entity it identifies, an expiration date, the name of the Certificate Authority that issued the certificate, a serial number and other identification. The certificate always includes the **digital signature** of the issuing Certificate Authority, which permits the certificate to function as a "letter of introduction" from the Certificate Authority. One example of public/private encryption keys is SSL (Secure Socket Layer), used on secure web sites.

Public key/private key encryption can be illustrated with an analogy. Imagine a door with two locks, one keyed to the public key, and the other keyed to the private key. Both locks are unlocked, and a pile of keys that fit the public key lock are available on a table nearby. When anyone wants to leave something in the room, they take a public key and lock the door. Upon locking the door with the public key, the private key lock is locked automatically. Only the person with the private key can open the door and look at what is in the room. Therefore, you know the message is both safe from being read by anyone else and that only the intended recipient can read it.

The most important point to remember here is that only someone with the private key (which should be closely guarded) can open the door and have access to the contents of the room. While it is possible to "pick the lock," doing so requires a large amount of time, skill and determination, just like in real life.

Businesses can use public key cryptography when sending information. If Ronnie Retailer needs to order from Smith Supply, they can use Smith Supply's public key to encrypt the information that they want to send via the Internet. Smith Supply can then use their private key to decrypt the message and process whatever transaction was requested. Anyone else who happens to intercept Ronnie Retailer's message will see only gibberish. This same process is also how your credit card information is sent securely to online merchants.

Question 215: A controller became aware that a competitor appeared to have access to the company's pricing information. The internal auditor determined that the leak of information was occurring during the electronic transmission of data from branch offices to the head office. Which of the following controls would be the most effective in preventing the leak of information?

- a) Asynchronous transmission.
- b) Encryption.
- c) Use of fiber-optic transmission lines.
- d) Use of passwords.

(CIA Adapted)

Contingency Planning

In any computer system, it is essential that the company have plans for the **backup of data** and the **recovery of data**, especially in the context of disaster recovery.

Several different processes and back up plans function as part of the backup and recovery plan.

- Program files, as well as data files, should be backed up regularly.
- Copies of all transaction data are stored as a **transaction log** as they are entered into the system. Should the master file be destroyed during processing, computer operations will **roll back** to the most recent backup; **recovery** takes place by reprocessing the data transaction log against the backup copy.
- Backups should be stored at a secure, remote location, so that in the event data is destroyed due to a physical disaster, it can be reconstructed. It would do very little good to have a backup tape in the same room as the computer if that area were destroyed by fire. Backup data can be transmitted electronically to the backup site through a process called **electronic vaulting**. The security of the remote location needs to be evaluated periodically.
- **Grandparent-parent-child processing** is used because of the risk of losing data before, during or after processing work. Data files from previous periods are retained and if a file is damaged during updating, the previous data files can be used to reconstruct a new current file. Like backup files, these files should also be stored off-premises.
- Computers should be on **Uninterruptible Power Supplies (UPS)** to provide some protection in the event of a power failure. Software is available that works in tandem with the UPS to perform an orderly shutdown of the system during that short period of power maintenance that the UPS can give the computer.
- **Fault-Tolerant Systems** are systems designed to tolerate faults or errors. They often utilize **redundancy** in hardware design, so that if one system fails, another one will take over. Computer networks can be made redundant in several ways:
 - With multiple processors, **consensus-based protocols** specify that if one processor disagrees with the others, it should be ignored.
 - With two processors, the second processor can serve as a **watchdog processor**. If something happens to the primary processor, the watchdog processor takes over.
 - A computer or server could have two disks and all data on the first disk is mirrored on the second disk. This is called **disk mirroring** or **disk shadowing**. Should one disk fail, the processing continues on the good disk.
 - **Rollback processing** may be used to prevent any transactions being written to disk until they are complete. If there is a power failure or another fault during processing, the program automatically rolls itself back to its pre-fault state at its first opportunity.
 - **Duplicate circuitry** is the double wiring of key hardware elements to ensure that if one circuit malfunctions, the other will take over.

- A **redundancy check** is the process of sending repeated sets of data to confirm the original data sent. **Summary processing** is a redundant process using a sum, which is compared with the control total from the processing of the detailed items.
- An **echo check** is the process of sending the received data back to the sending computer to compare what was actually sent to make sure that it is the same.
- In a **dual read check**, data is read twice during input and compared.
- **Boundary protection** is protection against unauthorized entry (read or write) to a tape, disk or other storage device.
- **Graceful degradation** means that if a part of the system malfunctions, other components can be programmed to continue the processing, although on a less efficient basis.
- **Overflow check** means that the data is checked and an error message activated if data is lost through arithmetic operations that exceed the planned capacity of the receiving fields.

Question 216: Management's enthusiasm for computer security seems to vary with changes in the environment, particularly with occurrence of the other computer disasters. Which of the following concepts should be addressed when making a comprehensive recommendation regarding the costs and benefits of computer security?

- I. Potential loss if security is not implemented.
 - II. Probability of occurrences.
 - III. Cost and effectiveness of the implementation and operation of computer security.
- a) I only.
 - b) I and II only.
 - c) III only.
 - d) I, II and III.

(CIA Adapted)

Disaster Recovery

Not many firms could survive for long without computing facilities. Therefore, an organization should have a formal disaster recovery plan to fall back on in the event of a hurricane, fire, earthquake, flood or criminal or terrorist act. A disaster recovery plan specifies:

- 1) Which employees will participate in disaster recovery and what their responsibilities will be. One person should be designated in charge of disaster recovery and another should be second in command.
- 2) What hardware, software and facilities will be used.
- 3) The priority of applications that should be processed.

Arrangements for alternative facilities as a disaster recovery site and offsite storage of the company's databases are also part of the disaster recovery plan. An alternative facility might be a different facility owned by the company, or it might be a facility contracted by a different company. The different locations should be a significant distance away from the original processing site.

Disaster recovery sites may be either hot sites or cold sites. A **hot site** is a backup facility that has a computer system similar to the one used regularly. The hot site must be fully operational and immediately available, with all necessary telecommunications hookups for online processing. A **cold site** is a facility where power and space are available to install processing equipment, but it is not immediately available. If an

organization uses a cold site, its disaster recovery plan must include arrangements to get computer equipment installed there quickly.

There are also several companies that operate "mobile recovery" centers. On a contracted basis, in the event of a disaster that destroys operations facilities, they arrive within hours in a tractor-trailer or van that is fully equipped with their client's platform requirements, 50 to 100 workstations and staffed with technical personnel to assist in recovery.

Personnel should be trained in emergency procedures and re-training should be done regularly to keep their knowledge fresh. The disaster recovery plan should be tested periodically by simulating a disaster in order to reveal any weaknesses in the plan. This test should be conducted using typical volumes, and processing times should be recorded. The disaster recovery plan should be reviewed regularly and revised when necessary, and the members of the disaster recovery team should each keep a **current** copy of the plan at home.

Question 217: A critical aspect of a disaster recovery plan is to be able to regain operational capability as soon as possible. To accomplish this, an organization can have an arrangement with its computer hardware vendor to have a fully operational facility available that is configured to the user's specific needs. This is best known as a(n):

- a) Uninterruptible power system.
- b) Parallel system.
- c) Cold site.
- d) Hot site.

(CMA Adapted)

Question 218: Each day after all processing is finished, a bank performs a backup of its online deposit files and retains it for 7 days. Copies of each day's transaction files are not retained. This approach is:

- a) Valid, in that having a week's worth of backups permits recovery even if one backup is unreadable.
- b) Risky, in that restoring from the most recent backup file would omit subsequent transactions.
- c) Valid, in that it minimizes the complexity of backup/recovery procedures if the online file has to be restored.
- d) Risky, in that no checkpoint/restart information is kept with the backup files.

(CIA Adapted)

Question 219: Good planning will help an organization restore computer operations after a processing outage. Good recovery planning should ensure that:

- a) Backup/restart procedures have been built into job streams and programs.
- b) Change control procedures cannot be bypassed by operating personnel.
- c) Planned changes in equipment capacities are compatible with projected workloads.
- d) Service level agreements with owners of applications are documented.

(CIA Adapted)

Section E – Professional Ethics

Introduction to Ethics

In the Part 1 exam, ethics may be tested in conjunction with any other topic area. We recommend that you memorize, but not only memorize, that you **understand** the items that are listed in the **IMA's Statement of Ethical Professional Practice**, which is reproduced on the following pages.

In today's modern world of business, individuals in management accounting and financial management constantly face ethical dilemmas. For example, if an accountant's immediate superior instructs the accountant to record the physical inventory at its original costs when it is obvious that the inventory has a reduced value due to obsolescence, what should the accountant do?

Ethics, in its broader sense, deals with human conduct in relation to what is morally good and bad, right and wrong. To determine whether a decision is good or bad, the decision-maker must compare his/her options with some standard. This standard is not a statement of static position but requires the decision-maker to assess the situation and the values of the parties affected by the decision. The decision-maker must then estimate the outcome of the decision and be responsible for its results. Two good questions to ask when faced with an ethical dilemma are, "Will my actions be fair and just to all parties affected?" and "Would I be pleased to have my closest friends learn of my actions?"

Business Ethics

Ethics concerns the morality of activities and practices that are considered right or wrong, including the rules and values that give rise to those activities and practices. Thus, business ethics is a systematic study of morality as it is applied to the business world.

Business ethics are considered an integral part of business and are usually officially incorporated into the culture of a company in one manner or another. This may be done very formally through the use of Value or Mission Statements, or informally through peer pressure and the culture that is set by the management team through their behavior. Business ethics form a key part of the culture of a company, and the issue of ethics has become even more central in businesses today as a result of several well-known accounting scandals and business failures over the past few years. By establishing corporate ethical standards, organizations endeavor to influence the behavior of the people who are working for the company.

Under the Sarbanes-Oxley Act, enacted into law in 2002 in response to some of these failures, a company is required to disclose whether or not it has adopted a Code of Ethics for its senior financial officers, and if not, why not. Three general principles are to be included in a company's Code of Ethics: (1) honest and ethical conduct; (2) full, fair, accurate, timely and understandable disclosure in SEC filings; and (3) compliance with applicable governmental rules and regulations.

Note: Customs and traditions in different parts of the world, and even in neighboring countries, make ethics a more complicated issue. What may be considered unethical in one part of the world may be seen as "business as usual" in another. Despite these local and regional elements of ethics, there is a shared understanding of what is considered ethical or unethical on a global level. For the CMA Exams, however, the issue of ethics is tested based on the ethics standard that has been established by the Institute of Management Accountants, the Statement of Ethical Professional Practice.

In practical terms, business ethics standards distinguish between desirable and undesirable behavior and actions in relation to the following, as well as among other considerations:

- General understanding of what is considered to be right or wrong,
- Compliance with laws and regulations, both external and internal,
- Resolution of conflicts,
- Conflict of interest,
- Whistle-blowing,
- Bribes and kickbacks, and
- Social responsibilities.

Despite the existence of various acts, codes and regulations addressing issues of business ethics on national, corporate and individual levels, there are always external and internal factors that may encourage unethical behavior.

- On the *individual level*, the personal judgment of an employee often depends on his or her personal life experience, educational background and social status. All of these are different for everyone and as a result, each individual may react differently to the same situations.
- On the *organizational level*, organization-specific features such as management style, group dynamics, remuneration/promotion systems and practices, performance evaluation, budgeting and reporting processes as well as overall condition of the business, are all important factors impacting the behavior of individuals in more or less significant ways. When companies are doing well and individuals are well compensated, there may be less desire to act in unethical ways because of the risk involved. However, when things in the company are bad, or an individual has little to lose personally, there is a greater inclination toward unethical behaviors.
- *Outside of the organization*, external pressures and influences such as those of competitors, investors, partners, customers, governments (especially in a different country) and other stakeholders may compel individuals to compromise their ethical standards. A firm working in different countries or cultures may find it particularly difficult to have employees adhere to a single set of rules and reach consensus on what should be considered right or wrong as applied to business practices.

These various factors may lead, in certain cases, to behaviors that are in contradiction with individual and corporate ethical standards. However, it must be noted that in some particular situations, opinions are divided as to what is considered "ethical action."

No one code of ethics can cover all possible cases and scenarios that an individual may face in reality. However, there are several general guidelines to help determine whether a particular action or behavior should be considered right or wrong.

The most important criterion of all is whether the particular action creates more benefits than harm to all parties who are directly or indirectly impacted by it. Many think that "all parties" should include society as a whole, the environment or, at an extreme, even space. (An issue in respect to space is the "pollution" of space with satellites and other spacecraft that have been launched and not returned to earth.)

The importance of adhering to the highest standards of business ethics is particularly highlighted in the wake of the massive corporate scandals that swept the business world in recent years.

Today, no one denies the importance of business ethics in the world of business. This is evidenced by the wide and extensive coverage in the media, numerous conferences, and legislative committees and political debates on this topic. In the U.S., this is most visible in the Sarbanes-Oxley Act. The Act provides that unethical activity in business can result in legal liability, not only of a corporate nature but also of a personal nature.

Individuals in management accounting and financial management have a unique set of circumstances relating to their employment. To address the issue of ethics for its members and to help them assess their situation and make a decision, the Institute of Management Accountants (IMA) has developed a Code of Ethics, called "Statement of Ethical Professional Practice." This code is provided in its full text on this and the following pages. This is the version that was adopted in August 2005.

We highly recommend that you read the "Statement of Ethical Professional Practice" carefully, know what it contains and most importantly, be able to apply it to situations. Questions on the exam require thorough knowledge of and the ability to apply these standards to cases presented in the questions.

The Part 1 exam consists of both multiple choice and essay questions. If an essay question includes ethical considerations, you should be able to cite the applicable standard or standards as part of your answer. You will need to be able to quote the portion you cite virtually word for word, so memorize it well. Paraphrasing it is not good enough.

Ethical Behavior for Practitioners of Management Accounting and Financial Management

Practitioners of management accounting and financial management have an obligation to the public, their profession, the organizations they serve, and themselves to maintain the highest standards of ethical conduct. In recognition of this obligation, the Institute of Management Accountants has promulgated the following standards of ethical professional practice. Adherence to these standards, both domestically and internationally, is integral to achieving the *Objectives of Management Accounting*. Practitioners of management accounting and financial management shall not commit acts contrary to these standards nor shall they condone the commission of such acts by others within their organizations.

Statement of Ethical Professional Practice

Members of IMA shall behave ethically. A commitment to ethical professional practice includes overarching principles that express our values, and standards that guide our conduct.

PRINCIPLES

IMA's overarching ethical principles include: **Honesty, Fairness, Objectivity, and Responsibility**. Members shall act in accordance with these principles and shall encourage others within their organizations to adhere to them.

Note: IMA's overarching ethical principles are: **Honesty, Fairness, Objectivity, and Responsibility**. In an essay answer to an ethics question on the exam, if you mention any of them, **you will need to be able to also define them**. The definitions, which are not part of the Statement, are:

Honesty means fairness and straightforwardness of conduct. It is the quality of being upright, having integrity, truthfulness, sincerity, frankness, and freedom from deceit or fraud.

Fairness means acting in an impartial manner and being free from bias, dishonesty or injustice. It requires a person to be open-minded, tolerant and accepting.

Objectivity means basing a judgment on an established set of criteria. It is the state of being unbiased, free from personal feelings or prejudice and basing analyses and decisions on the facts alone.

Responsibility means doing what you say you will do when you say you will do it. It is the state of being answerable or accountable for something that is within one's own power, control or management.

Note: The standards of ethical conduct are the four standards that are discussed in the following paragraphs: **Competence, Confidentiality, Integrity, and Credibility**.

STANDARDS

A member's failure to comply with the following standards may result in disciplinary action.

I. COMPETENCE

Each member has a responsibility to:

- 1) Maintain an appropriate level of professional expertise by continually developing knowledge and skills.
- 2) Perform professional duties in accordance with relevant laws, regulations, and technical standards.
- 3) Provide decision support information and recommendations that are accurate, clear, concise, and timely.
- 4) Recognize and communicate professional limitations or other constraints that would preclude responsible judgment or successful performance of an activity.

Note: Fulfilling the **competence** standard includes keeping up with changes in laws, regulations, accounting standards, and association rules and requirements. Some examples of these are:

- New guidance issued by the PCAOB and the SEC relating to requirements in the Sarbanes-Oxley Act.
- Generally Accepted Accounting Principles (GAAP), including U.S. standards issued by the Financial Accounting Standards Board (FASB) and International Financial Reporting Standards issued by the International Accounting Standards Board (IASB).
- Other national and state legislation specific to your industry.

Failure to keep informed about changes in these regulations could cause you to unknowingly commit an ethics violation or violate a legal requirement.

II. CONFIDENTIALITY

Each member has a responsibility to:

- 1) Keep information confidential except when disclosure is authorized or legally required.
- 2) Inform all relevant parties regarding appropriate use of confidential information. Monitor subordinates' activities to ensure compliance.
- 3) Refrain from using confidential information for unethical or illegal advantage.

Note: Here are some examples of ways to keep information confidential:

- Do not discuss confidential information in any public setting, either on a cell phone or face to face.
- Know who in your organization has access to confidential information and does not.
- Do not discuss confidential information with family or friends.
- Use passwords to protect documents and set permissions so only certain people are able to access them.
- Guard laptop computers against theft.
- Do not connect to the Internet using a connection that is not secure
- Delete permanently and destroy documents that are no longer needed
- If you are asked to disclose information and you are not sure whether you should do so, check company or other guidelines and standards before proceeding.

III. INTEGRITY

Each member has a responsibility to:

- 1) Mitigate actual conflicts of interest; regularly communicate with business associates to avoid apparent conflicts of interest. Advise all parties of any potential conflicts.
- 2) Refrain from engaging in any conduct that would prejudice carrying out duties ethically.
- 3) Abstain from engaging in or supporting any activity that might discredit the profession.

Note: Here are some suggestions for maintaining your integrity:

- Do not accept any gifts, favors or anything else that could cause you to feel an obligation to someone as that could influence what you may do in the future.
- If you have any conflict of interest in a situation, you should excuse yourself from any decision-making position.
- If you have any professional limitations that could impair the performance of your duties, you should make them known to your superiors.
- Do not just tell your superiors what they want to hear. Communicate both the good and the bad news.

IV. CREDIBILITY

Each member has a responsibility to:

- 1) Communicate information fairly and objectively.
- 2) Disclose all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, analyses, or recommendations.
- 3) Disclose delays or deficiencies in information, timeliness, processing, or internal controls in conformance with organization policy and/or applicable law.

Note: Credibility may involve things such as:

- Provide regular updates on projects you are working on.
- If news is bad, do not delay in giving it. Do not omit information. Omission is as bad as commission.
- If you will not be able to perform a task as you had expected to, let everyone concerned know as soon as you become aware of it.
- Gather all the necessary facts about a situation and do all the needed analysis. Request reports or recommendations, if appropriate.
- Assess risks ahead of time in order to be prepared.

RESOLUTION OF ETHICAL CONFLICT

In applying the Standards of Ethical Professional Practice, you may encounter problems identifying unethical behavior or resolving an ethical conflict. When faced with ethical issues, you should follow your organization's established policies on the resolution of such conflict. If these policies do not resolve the ethical conflict, you should consider the following courses of action:

- 1) Discuss the issue with your immediate supervisor except when it appears that the supervisor is involved. In that case, present the issue to the next level. If you cannot achieve a satisfactory resolution, submit the issue to the next management level. If your immediate superior is the chief executive officer or equivalent, the acceptable reviewing authority may be a group such as the audit committee, executive committee, board of directors, board of trustees, or owners. Contact with levels above the immediate superior should be initiated only with your superior's knowledge, assuming he or she is not involved. Communication of such problems to authorities or individuals not employed or engaged by the organization is not considered appropriate, unless you believe there is a clear violation of the law.
- 2) Clarify relevant ethical issues by initiating a confidential discussion with an IMA Ethics Counselor or other impartial advisor to obtain a better understanding of possible courses of action.
- 3) Consult your own attorney as to legal obligations and rights concerning the ethical conflict.

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Answers to Questions

- 1 d** – Monitoring is not a process of planning, but rather a review of what has already occurred.
- 2 b** – If plans are made too formal it prevents managers from pursuing new opportunities or making necessary decisions as a result of changes in the environment from what was planned.
- 3 b** – Strategic plans are long-term and therefore, the product mix for the current year is not a strategic plan.
- 4 b** – The objectives of the company have to be determined before anything else can be set.
- 5 c** – Top management must be involved in the budgeting process and this is usually by using the budget as a means to communicate the company goals.
- 6 b** – If top management sets the budget levels without any input from others in the company, nobody will support the budget as their own.
- 7 b** – The sales budget is the first budget that needs to be set.
- 8 d** – Selling and administrative budgets should be detailed enough to be useful, including the understanding of the assumptions underlying them.
- 9 b** – In zero-based budgeting, the budget starts with nothing in it and all costs need to be justified each year.
- 10 b** – To solve a flexible budget problem we need to determine the standard cost per unit and then use this at the actual level of production. If the budget called for 144,000 units at a cost of \$180,000, the standard cost per unit was \$1.25 ($\$180,000 \div 144,000$). If actual production was 10,800 units, the cost should have been \$13,500 ($10,800 \text{ units} \times \$1.25 \text{ per unit}$).
- 11 c** – There is a lot of information in this question, but much of it is not needed. We are told what the formula is and that the actual shipping was 12,300 pounds. Putting this into the formula, we get: $\$16,000 + (\$.50 \times 12,300) = \$22,150$.
- 12 b** – Again, when making flexible budget calculations we need the standard rate per unit. In this budget, the contribution per standard unit is \$6.50 ($\$975,000 \text{ contribution} \div 150,000 \text{ units}$). If they sold 180,000 units the total contribution would be \$1,170,000. Subtracting the fixed costs of \$750,000 from this, we get the total profit at 180,000 units of \$420,000.
- 13 c** – In order to solve this problem we need to determine a total fixed cost and the variable cost per unit. The total fixed costs are \$200,000 (\$100,000 each of manufacturing and selling costs). The total variable costs in the 100,000-unit budget are \$450,000. This gives a standard variable cost of \$4.50 per unit. Therefore, to produce 110,000 units the company will incur \$495,000 in variable costs and \$200,000 in fixed costs for a total of \$695,000.
- 14 c** – We again need to use the same formula to determine production amounts, but this time instead of doing it for a month, it is done for a quarter. This is not a problem because the formula works for any period of time. We first need to calculate the level of sales in each month, given a 5% increase each month. The expected sales are: July – 200,000; August 210,000; September – 220,500; and October – 231,525. Though October is not in this period we need it to calculate ending inventory levels. The units needed for the quarter are 630,500 and since ending inventory needs to be 80% of the next month's sales, this is 185,220 ($231,525 \times .80$). There are only 150,000 units in beginning inventory so the company will need to produce 665,720 units during the quarter ($630,500 + 185,220 - 150,000$).
- 15 c** – In order to determine the total cost of materials, we need to know how many units must be purchased. They will produce 600,000 finished units and since each finished unit requires 4 units of materials, they will need 2,400,000 units of material just for production. Ending inventory is 25% of the usage this period or 600,000. We are told that they had 800,000 units in beginning inventory so they will need to purchase only 2,200,000 units at \$1.20 per unit. This is a total materials cost of \$2,640,000.
- 16 c** – This is a basic question of units needed in a period, but it is about the number of units of the raw materials that are needed. There are 3 units of raw materials in a finished unit. The amount needed in the third quarter itself is 102,000 units of raw materials ($3 \times 34,000 \text{ finished units}$). In addition, the ending inventory is 30% of the next quarter's needs. This is 43,200 units of raw materials ($48,000 \text{ finished units} \times 3 \times .3$). The beginning inventory was 30% of the current quarter's needs or 30,600 ($102,000 \times .3$). This means that a total of 114,600 units of raw materials need to be purchased this period.
- 17 b** – This is a very long question, but with only a few important pieces of information. In January, the production will be equal to 1.5 times the expected sales in February. Expected February sales are 36,000 so in January the company will produce 54,000 units.
- 18 b** – In February the production will be equal to $1 \div 2$ of March sales. March sales are expected to be 33,000, so February will see production of 16,500 units. The variable cost per unit is \$7 ($\$3.50 + \$1 + \$2 +$

\$.50), so total variable costs will be \$115,500. We need to add to this the \$12,000 of fixed costs giving us a total production cost of \$127,500.

19 c – This question is much easier if you use the formula given for how to calculate the number of units that a company needs to produce or purchase within a given time period in order to meet the demand for that period and the opening beginning inventory required for the next month. That formula is:

Units needed for use in the current period
 Plus Units needed for next month's beginning inventory (i.e., ending inventory)
 Minus Units on hand at the beginning of this period (i.e., beginning inventory)
 Equals Units needed to be made or purchased this period

In August the company needs to have 2,500 tables to sell. They also need 840 units in ending inventory. This is 40% of September's sales (2,100 tables). In beginning inventory they have 1,000 tables. We know this because the ending inventory is always 40% of the next month's sales. So, July's ending inventory (which is also August's beginning inventory) would have been 1,000 units (40% of 2,500). So, they need in total 3,340 tables in August and already have 1,000. They will need to produce 2,340 tables during August.

20 b – This question is about table legs instead of tables, but still uses the same formula as the previous question. They need 6,400 table legs in August if production will be 1,600 tables. Since the policy is to have 60% of the next month's needed table legs in ending inventory, they will need 4,320 in ending inventory (1,800 tables $\times$ 4 legs per table $\times$.6). The beginning inventory was 4,200 (this was given in the problem). Since they need 10,720 table legs in August and have only 4,200, they will need to purchase 6,520.

21 a – Because this is a mathematical calculation, there are different ways it can be done. One of them is as follows: 1,800 units will be produced and each table needs 20 minutes. That is 36,000 minutes or 600 hours. Each employee works 160 hours a month, so 3.75 employees will be needed.

22 d – This is a very large question with a couple of minor details that are essential to getting the question correct. It is, however, the same basic premise as the previous questions about how many units need to be produced or purchased. The first thing that we need to do is determine how many bicycles and tricycles need to be produced. The number of bicycles that will be sold is 130,000. However, during the period, inventory will decrease by 1,250 units, so this means that only 128,750 bicycles will be produced. The sales of tricycles will be 96,000, but during the year inventory will increase by 200, so production needs to be 96,200. We now need to calculate how many of part A19 will be needed during the period. There are 2 A19 in a bicycle and 2 in a tricycle. This is a total of 449,900 units of A19 ((128,750 $\times$ 2) + (96,200 $\times$ 2)).

We are told that the ending inventory for A19 is 2,000 and the beginning inventory is 3,500. So, 448,400 units must be purchased during the period (449,900 + 2,000 – 3,500). At a cost of \$1.20 per unit, this is a total budgeted cost of \$538,080.

23 b – This is almost the same as the previous question, but for a different part and we need to know how many times they must order it, given an order quantity of 70,000 units. We will use the same production numbers of bicycles and tricycles as in the previous question, so the calculation of unit B12 is as follows: ((128,750 $\times$ 4) + (96,200 $\times$ 1)) = 611,200 units needed for production during the period. Given a beginning balance of 1,200 units and an ending balance of 1,800 units the total number to be purchased is 611,800. Since 70,000 can be ordered at a time, they must order 9 times (it is really 8.74, but it is not possible to use .74 of a time, so we must round up to 9).

24 c – To calculate collections we need to go through each month to determine how much of that month's sales were collected and how much of the previous month's sales were collected. The company collects 50% of the credit sales in the month of the sale and 45% in the following month. Therefore, the collections in the third quarter are:

	50% of this month	45% of last month	TOTAL
July	\$70,000	\$54,000	\$124,000
August	\$80,000	\$63,000	\$143,000
September	\$75,000	\$72,000	<u>\$147,000</u>
			<u>\$414,000</u>

25 b – This question is very similar to a previous question, except for a small and critical difference. In that question, 50% of the sales were collected in the month of the sale, 45% in the month after and 5% never collected. In this question, 5% are never collected, and then 60% of the amount that will be collected is collected in the month of the sale. Notice the difference in that in this month it is not 60% of the total credit sales, but rather 60% of the credit sales that will be collected. It is critical that you recognize what percentage of what is being collected. So, in December they will collect 40% of 95% of the November credit sales.

November credit sales were \$240,000. Of this, 95% will be collected, or \$228,000. Of this 40% will be collected in December, or \$91,200.

26 c – The budgeted cash receipts in January will include the cash collections on December and January credit sales as well as the cash sales from January. January cash sales were \$60,000. Collections on December sales will be \$136,800 ($\$360,000 \times .95 \times .4$), and collections on January credit sales will be \$102,600 ($\$180,000 \times .95 \times .6$). In total, \$299,400 will be collected in January.

27 c – This question is asking only about how much money (if any) Raymar will need to borrow in April. Since they also need to have a \$100,000 balance at the end of April, the amount that they will need to borrow is the amount by which disbursements exceed collections in April. So, we need to make 2 calculations, what they received and what they paid. We will look first at what they received. In April, they will collect 50% of the April sales (\$50,000) and 50% of the March sales (\$40,000). This is \$45,000 and represents the amount collected in April. In April, they will also need to pay 75% of April payables (\$40,000) and 25% of March payables (\$30,000). This is in total \$37,500. However, they also have \$100,000 of total payroll and other disbursements. This brings their total payments in April to \$137,500. This is \$92,500 more than their receipts. However, as they are able to borrow only in increments of \$10,000, they will need to borrow \$100,000 in order to maintain a minimum balance of \$100,000 at the end of April.

28 d – In this question we will need to determine not only how much money will need to be borrowed in May (if any), but also how much interest will need to be paid in May as well. We will start by looking at the amount that needs to be borrowed. This is done in much the same manner as the previous question, calculating the amount of cash paid and received in May. The collections are 50% of April sales (\$50,000) and 50% of May sales (\$100,000). This is \$75,000 received. The disbursements are 75% of May payables (\$40,000) and 25% of April payables (\$40,000). This is \$40,000, to which we need to add the \$60,000 of payroll and other disbursements. This is a total of \$100,000 in disbursements. This gives a \$25,000 shortfall in May that will need to be made up by borrowing. This would appear to require \$30,000 in borrowings. However, at the end of April the cash balance was not \$100,000, but \$107,500 as a result of the need to borrow in even \$10,000 amounts. Therefore, they do not need to borrow the full \$25,000, but only \$17,500. This requires a loan of \$20,000. Now we need to look at the interest. Given that they borrowed \$100,000 in April, they will need to pay 1% of this in May, or \$1,000.

Note: This question will not appear like this on the Exam because in order to get the May question correct, as it is asked, you must have also gotten the April question correct. On the Exam they would give you information about April for the May question.

29 d – By definition the coefficient of correlation measures the strength of the relationship between two variables.

30 b – The relationship between these two variables is a perfectly direct relationship – as x increases by 1, y decreases by 2. Since the variables move in the opposite direction it is a perfectly negative relationship, represented by -1.

31 b – Under exponential smoothing, the most recent results are given more weight than results further in the past. Since the last nine months have seen a significant change, it is important to give more weight to recent results.

32 c – The regression coefficient must lie between -1 and +1. The closer the absolute value of the coefficient to 1 the stronger the relationship is. Among the alternatives, -0.89 has the highest absolute value that is not greater than +1 or less than -1.

33 d – According to the regression analysis formula ($y = a + bx$), inserting in the formula the values given: $y = 684.65 + (7.2884 \times 420)$; $y = 684.65 + 3061.128$; $y = 3745.78$

34 a – By definition. R^2 , or the coefficient of determination, represents the percentage of the total amount of change in the dependent variable that can be explained by changes in the independent variable.

35 d – Using cumulative average time learning, when the total quantity of units produced doubles, the cumulative average time per unit required for all the units produced is X% of the cumulative average time per unit required for the original number of units. This question gives labor costs instead of labor time, but since the question also asks for total labor cost, we can use the costs the same way we would use time. We are told that the average labor cost for the first batch is \$120 per unit and the cumulative average labor cost after the second batch (the first doubling) is \$72 per unit. From this, we can calculate that the learning curve is 60% ($72 \div 120 = .6$). If the average cost per unit for the first two batches is \$72, then the average cost per unit for all four batches (after the fourth batch – the second doubling) is $\$72 \times .6$, or \$43.20. Since each batch contains 100 units, 4 batches contain a total of 400 units. If the average cost per unit is \$43.20, the total cost for 400 units (4 batches) is $\$43.20 \times 400$, or \$17,280.

36 a – We have to include the first 50 units manufactured in this analysis, since they contributed to the learning curve. So we will analyze the cost for the first 200 units and then subtract from that the cost for the

first 50 units in order to calculate the cost for units numbered 51 through 200, which are the units in the second order of 150.

The first doubling takes place at unit no. 100. The second doubling takes place at unit no. 200. Therefore, the total 200 units required 2,560 hours, calculated as follows:

$1,000 \text{ hours} \times (.8 \times 2) \times (.8 \times 2) = 2,560 \text{ hours for 200 units. } 2,560 \text{ hours for 200 units less the } 1,000 \text{ hours required for the first 50 units} = 1,560 \text{ hours for the last 150 units.}$

Since variable overhead is applied on the basis of direct labor hours, we can say that variable costs per direct labor hour are $\$8.50 + \$4.00$, for a total of $\$12.50$ per DLH.

Therefore, total costs for the 200 units are:

Direct materials: $\$1,500 \div 50 \times 200 =$	\$ 6,000
Direct labor & Variable OH: $2,560 \times \$12.50$	32,000
Fixed OH: 10% of total variable cost of $\$38,000$	<u>3,800</u>
Total cost for 200 units	\$41,800
Less: Cost for first 50 units	<u>15,400</u>
Total cost for last 150 units	<u>\$26,400</u>

37 d – Since there are two doublings, the number of hours required for 200 units using a 70% learning curve is: $1,000 \text{ hours} \times (.7 \times 2) \times (.7 \times 2) = 1,960 \text{ hours. } 1,960 \text{ hours required for 200 units less } 1,000 \text{ hours required for the first 50 units} = 960 \text{ hours required for the last 150 units. } 960 \text{ hours} \div 150 \text{ units} = 6.4 \text{ hours required per unit for the last 150 units.}$

38 d – Risk-averse decision-makers prefer the lowest dispersion given that the expected values are close to each other. The expected values for these two product lines are the same: $0.2 \times 500 + 0.7 \times 300 + 0.1 \times 600 = 370$ versus $0.2 \times 50 + 0.7 \times 400 + 0.1 \times 800 = 370$. Therefore, with dispersion measured as the range of possible values, the highest dispersion belongs to Product Y, so the company should choose Product X.

39 a – The probability of two events happening simultaneously is calculated by multiplying the chance of each item happening together. In this question, that is $0.3 \times 0.5 = 0.15$.

40 b – In case of investigation, total costs will be equal to the sum of the cost of investigation itself (\$6,000) and the expected cost of correction ($\$18,000x$), where “x” is the probability of improper operations. The expected cost of not doing an investigation is $\$33,000x$. Equating both sides would allow us to find x. So, $33,000x = 6,000 + 18,000x$. Solving for x gives 0.4. This means that if the probability of an improper operation is 40%, Bagley is indifferent as to whether or not he investigates.

41 d – The total percentage of damaged goods for Ryerson Company is equal to the sum of the damage rates for each department: Clothing ($50\% \times 2\% = 1\%$); Hardware ($30\% \times 5\% = 1.5\%$); Sundries ($20\% \times 2.5\% = 0.5\%$), which is 3% in total. The probability that the damage occurred in Clothing department is $1\% \div 3\% = 33 \frac{1}{3}\%$.

42 d – To solve this problem an equilibrium must be found – this is when the number of customers leaving firm A is equal to the number of customers leaving firm B. Suppose that the total number of customers is represented by 100%, or 1. Let us then assume that the number of customers in Firm A is X. From this, we know that the number of customers that Firm B has is $1 - X$. We also know that going forward Firm A will get 20% of the customers from Firm B, but lose 30%; therefore the number of customers that Firm A will lose is $.3X$, while the number of customers that Firm B will lose is $.2 \times (1 - X)$. Setting these two equations together, we get $.3X = .2 - .2X$. Solving for X we get .40, and this is the percentage of customers Firm A will have in the long run.

43 d – The expected payoff for selling coffee is the sum of the product of individual payoffs times the probability of the corresponding states of nature: $0.4 \times \$1,900 + 0.6 \times \$2,000 = \$1,960$.

44 c – Top management should not be involved in setting budget standards for production as this is a very low-level activity that is best done by the people more directly involved.

45 d – Standard costing systems are often and best used together with a flexible budget. By using standard costs, the firm can prepare the flexible budgets that enable better analysis at the end of the period.

46 a – The efficiency variance measures the actual usage of the materials against the standard that should have been used. This usage is mostly under the control of the production department and industrial engineering.

47 d – If the company buys lower quality materials, there will be a favorable price variance. However, because the input materials are of a lower quality, it is very possible that a higher than normal quantity will need to be used because the lower quality materials may break or be damaged or unusable in some cases because of the lower quality.

48 b – The price variance formula is $(AP - SP) \times AQ$. Putting the numbers from the question into the formula, we get $(.75 - .72) \times 4,100$. (Remember that in the price variance we use the number of units **used** in production, unless the problem asks for the **purchase** price variance.) This gives us an unfavorable variance of \$123.

49 b – The standard price is calculated using budgeted amounts. ChemKing expected to make 12,000 units, which would require 24,000 units of raw material. Since the budgeted cost of these raw material units was \$60,000, the standard cost per unit is \$2.50 ($\$60,000 \div 24,000$).

50 d – In this question, we need to solve for AQ and since we are given the quantity variance in the question, we can use this formula: $(AQ - SQ) \times SP = \text{Quantity Variance}$. Or, $(AQ - 24,000) \times \$2.50 = \$2,500$. Solving for AQ we get 25,000. We also could have solved this in the following manner: because the standard price for each unit of material was \$2.50 and ChemKing's quantity variance was \$2,500 unfavorable, it must have used 1,000 units of raw materials too many. The standard is 2 units of material for each unit of output, so for 12,000 units of output, the standard would be 24,000 units of material. Thus, the actual units of raw material used were $24,000 + 1,000$, or 25,000.

51 c – The formula for the price variance is $(AP - SP) \times AQ$. Using the amounts in the questions, we get $(\$3.00 - \$2.50) \times 25,000 = \$12,500$ Unfavorable. We know that the actual price was \$3.00 per unit because the company bought 35,000 units for \$105,000.

52 b – If the company has an unfavorable materials usage variance, this will mean that more materials were used than necessary. This in turn may cause more labor hours in order to handle and process the additional materials. Therefore, the unfavorable materials usage variance may also cause an unfavorable labor variance as well.

53 c – If a new labor contract has been signed prior to the budgeting cycle, the new labor rates should have been incorporated into the budget. Therefore, this is not an explanation of a labor price variance.

54 d – The actual sales volume of the product will not impact the materials efficiency variance. The difference between sales and production does not affect the comparison of how much material should have been used in the production and how much actually was used.

55 d – In order to calculate the labor efficiency variance, we need to use the following formula: $(AQ - SQ) \times SP$. The standard price is \$12 per direct labor hour. The standard number of hours for the level of production is 6,500 ($5,200 \text{ units} \times 1.25 \text{ hours per unit}$). The actual number of hours was 6,600. Putting this into the formula, we get $(6,600 - 6,500) \times \$12 = \$1,200$. This is a \$1,200 unfavorable variance.

56 d – To solve for the direct materials usage variance, we need to solve the following equation: $(AQ - SQ) \times SP$. The standard price is \$3.60 per pound and the standard quantity required to produce the actual quantity of output is 110,000 ($22,000 \text{ units} \times 5 \text{ pounds per unit}$). We are told that the actual quantity used was 108,000. Therefore, the formula is $(108,000 - 110,000) \times \$3.60$ and this gives us a favorable variance of \$(7,200).

57 a – To solve for the direct labor rate variance, we need to solve the following equation: $(AP - SP) \times AQ$. The actual quantity of labor hours was 28,000 and the standard rate is \$12.00 per hour. The actual rate may be calculated by dividing the actual cost of \$327,600 (this is calculated as 90% of the total labor cost) by the actual hours worked of 28,000. This gives an actual labor rate of \$11.70. Putting these numbers into the formula, we get $(\$11.70 - \$12.00) \times 28,000$. This gives us a favorable variance of \$(8,400).

58 b – To solve for the labor usage variance, we need to solve the following equation: $(AQ - SQ) \times SP$. The standard price was \$12.00 and the actual quantity was 28,000. The standard quantity for the actual level of output is 27,500 ($22,000 \text{ units} \times 1.25 \text{ hours per unit}$). Putting these numbers into the formula, we get $(28,000 - 27,500) \times \$12$, and this gives us an unfavorable labor usage variance of \$6,000.

59 d – The materials mix variance equals the actual total quantity used times the difference between the weighted average standard price for the actual mix per unit and the weighted average standard price for the standard mix per unit. The weighted average standard price for the actual mix was $(21,000 \times \$0.75) + (14,000 \times \$0.90) = \$28,350$. So, the weighted average standard price for the actual mix per unit was \$.81 ($\$28,350 \div 35,000 \text{ kg}$). The weighted average standard price for the standard mix is \$.80 per unit. ($\$240 \text{ standard total cost per batch} \div 300 \text{ standard total kg per batch}$), and the mix variance was \$350 unfavorable: $(\$0.81 - \$0.80) \times 35,000 = \$350$.

60 b – The materials yield variance equals the weighted average standard price for the standard mix per unit multiplied by the difference between the actual total quantity used and the standard total quantity for the actual output achieved. The weighted average standard price for the standard mix is \$.80 per kg. ($\$240 \text{ standard total cost per batch} \div 300 \text{ standard total kg per batch}$). The actual total quantity used is 35,000. The standard total quantity for the actual output achieved is $300 \text{ kg per batch} \times 110 \text{ batches} = 33,000 \text{ kg}$. So, the yield variance was \$1,600 unfavorable: $(35,000 - 33,000) \times 0.80 = \$1,600$.

61 b – The variable overhead efficiency variance is calculated as $(AQ - SQ) \times SP$, where SP is the budgeted application rate. Given that 5,000 units were produced, the standard quantity of DLH would be 10,000. Given that the actual hours was 10,500 and that the standard rate was \$3, we get $(10,500 - 10,000) \times 3 = \$1,500$, and an unfavorable variance of \$1,500.

62 b – By definition, the fixed overhead volume variance is the difference between the budgeted and the applied fixed overhead.

63 b – If overhead is applied based on direct labor hours and the direct labor efficiency variance is unfavorable, the variable overhead efficiency variance will also be unfavorable. This is because the amount applied as overhead is more than was budgeted because the actual hours were more than budgeted.

64 c – The fixed overhead volume variance results from a difference between actual and budgeted production. This does not relate to an expenditure problem in which either too much is paid or too much is used. Therefore, this is the least significant variance for cost control.

65 b – The standard hours for each unit is 2. Since Franklin Glass Works produced 198,000 units, the standard total hours should be 396,000 $(198,000 \times 2)$.

66 a – To solve for the variable overhead efficiency variance, we need to solve for the following equation: $(SQ - AQ) \times SP$. In order to calculate the standard variable overhead allocation rate, we need to determine what the total variable overhead was budgeted to be. We are told that the total budgeted overhead is \$900,000 and that the fixed overhead is \$3 per unit. If there were 200,000 units budgeted, the total budgeted fixed overhead was \$600,000. This leaves variable overhead of \$300,000. Since 200,000 units were budgeted and there are 2 hours per unit, that gives a total of 400,000 budgeted hours. Calculating the allocation rate now, we get \$.75 of variable overhead per direct labor hour $(\$300,000 \div 400,000 \text{ hours})$. The actual number of hours was 440,000 and the standard number of hours was 396,000. Therefore, the formula looks as follows: $(440,000 - 396,000) \times \$.75$ and the variance is an unfavorable \$33,000.

67 c – To solve for the variable overhead spending variance, we need to solve for the following equation: $(AP - SP) \times AQ$. We know that the standard price was \$.75 and that the actual hours were 440,000. The actual price is calculated as the actual variable overhead $\div$ actual direct labor hours, or $\$352,000 \div 440,000 = \$.80$ per hour. We can now put these figures into the equation and get $(\$.80 - \$.75) \times 440,000$. The variance is an unfavorable \$22,000.

68 b – To solve for the fixed overhead spending variance, we must subtract budgeted fixed overheads from the actual fixed overheads. The actual fixed overheads were \$575,000 and the budgeted fixed overheads were \$600,000 (as calculated for the question above). Therefore, the fixed overhead spending variance is a favorable \$25,000.

69 c – The amount of fixed overhead applied is calculated as the application rate (\$3 per unit) multiplied by the number of units produced (198,000). This gives us fixed overhead applied of \$594,000.

70 a – The fixed overhead volume variance is calculated as the budgeted overhead minus the applied overhead, and a positive amount is unfavorable. The budgeted amount was \$600,000 and the applied amount was \$594,000, so the volume variance is an unfavorable \$6,000.

71 a – This is an example of a sales price variance that is analyzing sales **price**. The actual sales price was \$11.50 $(\$92,000 \div 8,000)$ and the standard price was \$10.50 $(\$105,000 \div 10,000)$. Putting this into the formula $(AP - SP) \times AQ$ and having 10,000 as the actual quantity, we get $(11.50 - 10.50) \times 8,000$. Since this is an income item, a positive variance is favorable.

72 b – This question is asking for the Sales Volume Variance for operating income. As a reminder, the sales volume variance can be applicable to any line of the income statement. The term "sales" does not refer exclusively to the revenue line. There are two ways to calculate this. One is to calculate the Sales Volume Variance for the contribution margin. The second way is to simply subtract the Static Budget Operating Income from the Flexible Budget Operating Income. To calculate the Sales Volume Variance for the contribution margin, we compare actual quantity to the static budget quantity. The formula is $(AQ - SQ) \times SP$, with the standard contribution margin per unit used for SP . The standard contribution per unit is \$10 $(\$120,000 \div 12,000 \text{ units})$; the actual quantity was 11,000 and the standard quantity was 12,000. Therefore, we get an unfavorable variance of \$10,000: $(11,000 - 12,000) \times \$10 = \$(10,000) \text{ U}$. We can also subtract the Static Budget Operating Income from the Flexible Budget Operating Income, as follows: $\$38,090 - \$48,000 = \$(10,000) \text{ Unfavorable}$.

73 d – For a single product firm such as this one, we can calculate flexible budget amounts for variable lines by dividing the static budget variable amount by the static budget number of units to get the budgeted amount per unit, and multiplying that figure by the actual number of units sold. In the static, or master, budget, the contribution per unit is \$4 per unit $(\$40,000 \div 10,000 \text{ units})$. Therefore, if we actually sold 12,000 units, we would expect the contribution margin to be \$48,000 $(\$4 \times 12,000 \text{ units})$, and that is the flexible budget amount for the contribution margin. From this, we need to subtract budgeted fixed costs of

\$30,000 (which do not change from the static budget amount), and we get a flexible budget operating income of \$18,000 at a sales level of 12,000 units.

74 c – The sales volume variance for the contribution margin is calculated as $(AQ - SQ) \times SP$, where SP is the standard (or budgeted) contribution margin. The actual quantity was 12,000 and the standard quantity was 10,000. The standard contribution margin per unit was \$4. This gives us a favorable sales volume variance of \$8,000; $(12,000 - 10,000) \times \$4$. The sales volume variance for the contribution margin and the sales volume variance for operating income are the same, since the sales volume variance for fixed costs is zero. Therefore, the sales volume variance can also be calculated by subtracting the static budget operating income of \$10,000 from the flexible budget operating income of \$18,000. $\$18,000 - \$10,000 = \$10,000$ Favorable.

75 a – The sales quantity variance formula is $(AQ - SQ) \times SP$, where we use contribution margin as the price. The standard contribution margin is \$2.50 per unit ($\$6 - \$3.50$). Given an actual quantity of 42,000 units and a standard quantity of 40,000 units, we get a favorable sales quantity variance of \$5,000; $(42,000 - 40,000) \times 2.50 = \$5,000$. Since this is a positive amount for a line that increases net operating income, it is a favorable variance.

76 a – We need to notice that this question is about the product costs that are under the control of the warehouse supervisor. The supervisor controls both receiving and shipping, but shipping is a selling cost (expensed in the period in which it is incurred) and not a product cost. Therefore, the costs for the shipping department, even if they are controllable by the supervisor, are not part of the answer. The supervisor's salary is not controllable by the supervisor, so it is only the salary and the benefits of the receiving department that the supervisor can control. The salary is \$75,000 and the benefits are 30% of this amount (\$22,500). So, in total, the supervisor is able to control \$97,500 of costs.

77 d – By definition.

78 c – By definition.

79 d – By definition. Direct fixed costs controllable by others are the same as non-controllable traceable fixed cost.

80 a – Contribution is calculated as sales minus the variable costs for the units sold. The sales price is \$100 per unit and the variable costs are: DM - \$30; DL - \$20; other variable manufacturing costs - \$10; Variable selling costs - \$12. Thus, contribution is \$28 per unit. 900 units were sold giving a contribution of \$25,200.

81 d – When the transfer price is based on actual costs, there is no incentive for the producer to control costs and as such, the company may make decisions that are not best for the company as a whole.

82 d – The transfer price should be between the variable costs of production (\$12) and the market price (\$20). \$18 is the only option between these amounts.

83 d – When operating below capacity, the minimum price that the producing department will sell for is the variable cost of production; \$7 in this question.

84 b – Because the alpha division is operating at capacity, the minimum price it will charge an internal division is the market price. The market price per unit is \$50.

85 d – Since the transfer price that has been set is the market price, this is market-based transfer pricing.

86 c – ROI is calculated as $\text{income} \div \text{invested capital}$. The income of the company was \$11,000 ($\$311,000 - \$250,000 - \$50,000$) and the invested capital was \$40,000. Therefore, the ROI was 27.5% ($\$11,000 \div \$40,000$).

87 d – ROI is calculated as the net income divided by the average invested assets. In this problem, average invested assets includes the property, plant and equipment and the working capital. This makes the average investment \$2,400,000. The net income is calculated as sales minus expenses, or $\$4,000,000 - \$3,525,000 - \$75,000 = \$400,000$. The ROI is then $\$400,000 \div \$2,400,000$, or 16.67%.

88 d – Shareholders' equity is usually not used in the ROI calculation because decisions about equity are made outside of the control of the people being evaluated.

89 b – By calculation. One way to solve this problem is to simply set up a basic ROI of, for example, $(\$500,000 - \$400,000) \div \$400,000 = 0.25$ and then go through the choices changing these figures outlined in each option. $(\$500,000 - \$350,000) \div \$450,000 = 0.33$.

90 d – Residual income is the excess of income over the target level of income. The target for Zack was 10% of the invested assets (\$200,000), or \$20,000. Since Zack's income was \$50,000, there was residual income of \$30,000.

91 c – By definition.

92 b – The target income for this company is \$30,000, as this is 6% of the assets of the company. As the income was only \$25,000, the residual income is \$(5,000).

93 b – Because residual income focuses on dollar return, this method will prevent a company from rejecting an investment that would be profitable from a cash standpoint, but simply has a lower % return than desired.

94 b – Conversion costs include direct labor and manufacturing overheads. In this question the direct labor is \$20 per unit and the manufacturing overheads are \$21 per unit giving a conversion cost of \$41 per unit.

95 d – Prime costs include direct materials and direct labor. In this question, these are \$32 and \$20, respectively, giving a prime cost per unit of \$52.

96 b – Total variable costs will include all variable costs, including direct materials and direct labor. These are $\$32 + \$20 + \$15 + \$3 = \$70$.

97 c – To calculate the total cost incurred we need to include both production and nonproduction costs and both variable and fixed costs. The per unit costs for the fixed costs were calculated using a 12,000 unit production level. Since there are \$10 of fixed costs per unit, there must have been \$120,000 of fixed costs incurred. The variable costs of production ($32 + 20 + 15$) are \$67 per unit and since 12,000 units were produced, this is \$804,000 of variable production costs. The last item to include is the variable selling costs. This is \$3 per unit and it is only incurred for units sold. Since 8,000 units were sold, \$24,000 of variable selling costs were incurred. Adding all of these together, we get the total cost of \$948,000.

98 b – Fixed overhead is treated as a period cost (not a part of a product cost) regardless of the level of sales. The full amount of these costs is expensed in the period, and income fluctuates with sales.

99 b – The difference between the two methods relates only to the fixed manufacturing overhead costs, and the amount of the difference is calculated as follows:

Fixed manufacturing costs per Unit $\times$ Change in the level of inventory

Using the information from the question we get $\$5.00 \times 5,000 = \$25,000$. Because this \$25,000 is put into inventory under absorption costing, the absorption method would have a higher profit because there is a lower cost of goods sold.

100 d – If the managers decrease production of any item, they will put fewer costs on the balance sheet since there will not be an increase in inventory. By putting fewer costs on the balance sheet there will be more costs on the income statement, reducing profit and bonus. All of the choices that include an increase in production will cause profits to be higher since some of the costs of production will be held in the balance sheet as part of finished goods inventory.

101 b – Under absorption costing, the fixed manufacturing costs are allocated to the products produced. The variable costs of production are \$30 per unit and the fixed costs per unit are \$3 ($\$600,000 \div 200,000$ units produced). In total, the cost per unit is \$33. Since the sales price was \$40 per unit, this is a gross profit of \$7 per unit. With 120,000 units sold, that is \$840,000. Subtracting from this the selling and admin costs of \$400,000, we get an operating income of \$440,000.

102 a – Under variable costing, the fixed manufacturing costs are expensed. With a variable cost per unit of \$30, there is \$10 of contribution per unit. This is, in total, \$1,200,000. Subtracting from this the fixed overhead costs and the selling and admin costs, we get an operating profit of \$200,000.

103 c – Under variable costing the fixed manufacturing overhead is simply expensed. The sales price is \$10 per unit and the variable cost of goods sold is \$6 (\$5.50 manufacturing and \$.50 selling). This gives a contribution of \$4 per unit. 1,000 units were sold giving a total contribution of \$4,000. From this we need to subtract the \$2,200 of fixed costs and get an income of \$1,800.

104 c – Under absorption costing, the fixed manufacturing overheads are allocated to each unit. The cost to each unit is \$1 ($\$1,200 \div 1,200$ units produced). With a sales price of \$10 and variable costs of \$7 (the \$6 from the previous question plus the \$1 of fixed manufacturing overhead), the gross margin is \$3,000. Subtracting the fixed selling and admin costs from this, we get a profit of \$2,000.

105 b – Under absorption costing, the cost per unit produced is \$30 ($\$12 + \$9 + \$4 + \$5$). This includes direct materials and labor, variable manufacturing overhead and fixed manufacturing overhead. Ending inventory was 40,000 units (35,000 units in beginning inventory and actual production was 5,000 units more than actual sales). This gives an ending inventory value of \$1,200,000 (40,000 units $\times$ \$30 per unit).

106 c – Under variable costing, the cost per unit was only \$25 ($\$12 + \$9 + \$4$). This is because the fixed manufacturing cost per unit is not included. Given an ending inventory of 40,000 units, the value of ending inventory was \$1,000,000 (40,000 units $\times$ \$25 per unit).

107 a – Under absorption costing the fixed selling (\$980,000) and administrative (\$425,000) costs are expensed in full. This is \$1,405,000 of fixed costs. Additionally, \$5 per unit of fixed manufacturing costs will be expensed for each unit sold. There were 125,000 units sold, so this is \$625,000. In total, this is now \$2,030,000 in expensed fixed costs. However, we are not done. The question states that any over- or under-applied overhead is closed to cost of goods sold. This means that any over- or under-applied overhead will be deducted from (in the case of over-applied) or added to (in the case of under-applied) the amount we

calculated above. Overhead was applied at \$5 per unit produced. 130,000 units were produced, so this means that \$650,000 of fixed overhead was applied. The actual incurred was \$715,000. This \$65,000 of under-applied overhead needs to be added to cost of goods sold (a form of expensing). This brings the total to \$2,095,000 of fixed costs that were expensed.

108 d – Manufacturing contribution margin is simply the sales price minus variable costs of production. The sales price was \$70 per unit and the variable costs are \$12 (materials) + \$9 (labor) + \$4 (variable overhead). This is \$25 of variable costs, giving a contribution per unit of \$45. 125,000 units were sold for a total contribution margin of \$5,625,000.

109 a – The variable costs per unit are a total of \$35. There were 125,000 units sold and this gives us a total variable cost of \$4,375,000.

110 b – The difference in income between these two methods is calculated as the fixed cost per unit $\times$ change in the level of inventory. The fixed cost per unit was \$5 and the change in inventory was 5,000 units. This is a \$25,000 difference between the two methods. The difference in income can be calculated in this way because the beginning finished goods inventory is valued at the same per unit manufacturing cost as the current year's planned per unit manufacturing cost and there is no beginning work-in-process inventory.

111 c – By definition.

112 a – In order to do this problem, we need to determine the total sales value of all of the produced units. We will then calculate what percentage of this total sales value comes from the MSB and this is the percentage of the \$300,000 of joint costs that will be allocated to the MSB. The sales value of the MSB is \$120,000 (\$2 per unit $\times$ 60,000 units), and the sales value of the CBL is \$360,000 (\$4 per unit $\times$ 90,000 units). In total, this is \$480,000, and the MSB is 25% of this total. Therefore, 25% of the joint costs, or \$75,000, is allocated to the MSB.

113 b – Using the relative sales value method, we will allocate the \$10,000 of joint costs to each product. Since product X has a sales value of \$12,000 and Y has a sales value of \$8,000, the total sales value is \$20,000. 60% of this is X, so X will receive 60%, or \$6,000, of the joint costs.

114 a – Net realizable value (NRV) is calculated as the selling price minus the costs to complete and dispose. Therefore, the NRV for one unit of each of the three products are as follows: F1 - \$2; F2 - \$5; F3 - \$10. However, since each of the individual products are not produced equally, we need to adjust this for how many of each of the three products can be produced. Five units of F1 would give a total NRV of \$10. Two units of F2 gives it a total NRV of \$10 and three units of F3 give it a total NRV of \$30. So, in total there is \$50 of NRV. Since product F1 is \$10, this is 20% of the total NRV and therefore it should receive 20% of the joint costs.

115 c – In this question the first thing we need to do is to reduce the costs to allocate by the sales value of the byproduct. The sales value of the byproduct is \$120,000 and this will reduce the costs to allocate to \$2,400,000. These costs are to be allocated based upon the physical volume of the two products. One has a volume of 90,000 and the second product has a volume of 150,000. In total this is 240,000, and since the second product is 150,000, the allocation is as follows: $\$2,400,000 \times 150,000 \div 240,000 = \$1,500,000$.

116 c – To solve this question, we need to use the following formula:

$$\text{Units in Beginning WIP} + \text{Units Transferred In} = \text{Units in Ending WIP} + \text{Units to FG}$$

In this formula, the 'units transferred in' is the same as the number of units started during the period. This gives us the following: $4,000 + X = 5,000 + 15,000$. Solving for X we get 16,000. In this question, the information about the percentage complete of BWIP and EWIP is unnecessary since the question is about physical units and not equivalent units.

117 c – In order to solve this, we need to use the three stages of work that can be done on a unit. To finish BWIP, Ben had to do 80% of the work on 200 units, giving 160 EUP to finish BWIP. There were 900 units (1,100 units completes – 200 units in BWIP) that were started and completed during the period, giving 900 EUP. There were 400 units in EWIP that had 80% of the work done, or 320 EUP. Adding these three EUP figures together gives us 1,380 EUP for May.

118 a – In this question we need to calculate EUP separately for materials and conversion costs. Materials are much easier because we are told that all materials are added at the beginning of the process. This means that the EUP for materials will be equal to the number of units started, which was 5,000. For conversion costs we will need to calculate the EUP to finish BWIP, the number of units that were started and completed and the number of EUP to start EWIP. To finish BWIP it required 800 EUP because the 2,000 units in BWIP were already 60% complete, leaving 40% of the work to be done this period. There were 4,000 units started and completed (6,000 units were completed and there were 2,000 units in BWIP) so these required 4,000 EUP. To start the EWIP required 400 EUP because the 1,000 units were 40% complete. In total there were 5,200 EUP of conversion costs.

119 a – As with the previous question, material EUP is very simple under FIFO when all materials are added at the beginning of the process. The EUP is equal to the number of units started during the period, or 5,000.

120 b – Under FIFO we need to make the same 3 calculations as we did in Question 19. In order to finish BWIP, 400 EUP were required (there were 1,000 units that were already 60% complete). There were 3,000 units started and completed (this is given in the question). There were 400 EUP to start EWIP. This gives us 3,800 EUP of conversion costs under FIFO.

121 d – Under weighted average we assume that the work that was in BWIP was done during the current period. Therefore, EUP for materials will include not only units started this period, but also the number of units in BWIP. This is 6,000 in total (5,000 started and 1,000 in BWIP).

122 d – Again, under weighted average we need to include the work that was in BWIP as well as the work actually done. As a result, the calculation of EUP has only two parts – units completed and start EWIP. The number of units completed was 4,000 and the EUP to start EWIP was 400. This gives a total of 4,400 EUP. The EUP under the weighted average method will never be lower than the EUP for FIFO.

123 d – In order to answer this question we need to determine the cost per EUP. Materials are easier since they have all been placed in production. This means that there have been 10,000 EUP of materials and with a materials cost of \$33,000, this gives a cost per EUP of \$3.30. Conversion costs (CC) are a little bit more involved, but not much. The EUP of CC is 8,000 for the finished goods and 25% of the units in EWIP. There are 2,000 physical units in EWIP so this means that there are 500 EUP of CC in EWIP. Since CC costs were \$17,000 and there were 8,500 EUP, this gives a cost per EUP of CC of \$2. So, in total a finished good costs \$5.30. There were 8,000 finished units, for a total cost of the units transferred out of \$42,400 (8,000 units × \$5.30).

124 d – The cost of the EWIP is calculated as follows for materials and CC – there were 2,000 EUP of materials in EWIP at a cost of \$3.30 per unit (\$6,600) and there were 500 EUP of CC in EWIP at a cost of \$2 per unit (\$1,000). In total there were \$7,600 of costs in EWIP.

125 c – Under the weighted average method to calculate the equivalent units, we simply need to add together the number of units completed and the number of EUP that were done in order to start the EWIP. In this question 92,000 units were completed and the 24,000 units in EWIP are 90% complete for materials, giving us 21,600 EUP in EWIP. This gives a total of 113,600 EUP of materials for the period. The total costs for materials under the weighted average method will include the costs used during the period (\$468,000) as well as the costs of the materials in BWIP (\$54,560). The total material cost is \$522,560 and this is divided by the 113,600 EUP giving us a cost per unit of materials of \$4.60.

126 c – Under the weighted average method to calculate the equivalent units, we simply need to add together the number of units completed and the number of EUP that were done in order to start the EWIP. In this question 92,000 units were completed and the 24,000 units in EWIP are 40% complete for conversion costs, giving us 9,600 EUP in EWIP. This gives a total of 101,600 EUP of conversion costs for the period. The total costs for conversion costs under the weighted average method will include the costs used during the period (\$182,880 + \$391,160) as well as the costs of the conversion costs in BWIP (\$20,320 + \$15,240). The total cost for conversion costs is \$609,600 and this is divided by the 101,600 EUP giving us a cost per unit of materials of \$6.00.

127 c – The first thing that we need to do is determine how many units are abnormal spoilage. Since 3% of the good units is considered normal, this comes to 60 baseballs (3% × 2,000 units passing inspection). Since there were 100 spoiled units and 60 is the normal spoilage, abnormal spoilage was 40 units. After this, we need to determine the cost per unit. Remember that we allocate costs to the spoiled units. Because there was no beginning or ending work-in-progress, we can treat all of the costs the same, giving a total cost of \$1,155. This is allocated to each of the 2,100 units produced, giving a rate of \$.55 per unit. This is the cost that is allocated to the 40 abnormally spoiled units, giving a total cost of \$22 for abnormal spoilage.

128 d – When there is no BWIP (as in January), FIFO and weighted average give the same EUP. However, when there is BWIP (as in February), weighted average will always give a higher EUP.

129 d – If there is no BWIP, but there is EWIP, the number of EUP will have to be less than the units placed into the process since not all of the units placed into the process were completed.

130 a – Because the beginning work-in-progress is 40% complete, the materials have already been added. However, as the ending work-in-progress is 20% complete, the materials have not been added. As a result, the materials were added this period only to the units that were started and completed. 85,000 units were completed during the period, but because there were 15,000 units in beginning work-in-progress, only 70,000 units were started and completed during the period.

131 b – Under the FIFO method, we need to make 3 calculations to determine the number of equivalent units of conversion costs. We need to determine the number of units required to finish the beginning work-in-progress, the number of units needed to start the ending work-in-progress and the number of units that were started and completed during the period. There were 20,000 units in beginning work-in-progress and they were 50% complete. This means that 50% of the work, or **10,000** equivalent units, was performed this period. There were 10 units in ending work-in-progress that were also 50% complete. This means that 50%

of the work, or **5,000** equivalent units, was done this period. 180,000 units were transferred out, but as there were 20,000 units in beginning work-in-progress, only **160,000** units were started and completed. Adding together these 3 numbers, we get 175,000 equivalent units of conversion costs.

132 d – This is simply a mathematical operation to determine how many units of spoilage are normal. 4% of inspected units are normal spoilage and 483,400 units were inspected (this is simply adding the passed and failed units together). If this many units were inspected, it would be expected that 19,336 would be spoiled. This is normal spoilage. The units above this, which were spoiled, are abnormal spoilage.

133 b – When the cost of normal spoilage is not accounted for separately, it is simply transferred to the next department as part of the cost of the good units. We need to calculate the cost per unit of all units produced – both good and spoiled units. In total, 5,500 units were produced at a cost of \$2,200. This is a cost per unit of \$.40. The cost for the 5,000 good units and the 300 normally spoiled units is transferred to the next department. This is 5,300 units at \$.40 per unit, or \$2,120. It can also be calculated as \$2,200 minus the cost of the abnormally spoiled units, which is 200 units at \$.40, or \$80.

134 d – The abnormal spoilage of \$50,000 is charged directly to the income statement in this period. The \$20,000 of normal spoilage is allocated to the 50,000 good units produced. This normal spoilage will then be on the income statement only when the units are sold. Since only half of the good units were sold, only 1/2 of the normal spoilage, or \$10,000, has been charged against revenue. So, the total spoilage costs on the income statement in May are \$60,000.

135 d – This question is actually fairly simple and just requires that we make 3 allocations of overhead. Overhead is allocated based on direct labor, raw materials and machine hours. These calculations, in this order, are: $\$8,000 \times 100\% = \$8,000$; $\$2,000 \times 20\% = \$400$; $140 \times \$117 = \$16,380$. These total \$24,780, but this is not the correct answer. This is the amount of overhead, but the question asks for total costs. This means that we need to include direct labor (\$8,000) and raw materials (\$2,000). The total costs are \$34,780.

136 b – The factory overhead control account accumulates the actual overhead costs. This includes indirect materials, indirect labor and other manufacturing overheads. The amount of indirect materials was \$5,000 and the amount of indirect labor was also \$5,000. The other overhead amounts were \$20,000, giving a total of \$30,000 of overhead costs in the overhead control account.

137 b – In this question overhead is allocated based on direct labor hours. The budgeted overhead is \$500,000, and the budgeted direct labor hours comes to 200,000. This gives us an application rate of \$2.50 of overhead for every 1 direct labor hour. Since the actual direct labor hours were 210,000, the company applied \$525,000 of overhead. This is \$10,000 more than the actual overhead and is the over-applied overhead.

138 b – We are told that the actual overhead was \$45,000 and that there was \$3,000 of over-applied overhead. This means that a total of \$48,000 of overhead was applied. Given that the overhead was applied at a rate of \$3 $[(40,000 + 20,000) \div 20,000 \text{ units}]$ per unit produced, there must have been 16,000 units produced in order to have \$48,000 applied.

139 d – By definition, cost drivers are the activities that cause costs to be incurred.

140 b – If the company produces only one product, all of the costs will end up being allocated to that product, no matter which method of allocation is used.

141 a – If the overhead costs are allocated based upon direct labor hours, the mirrors and the windows will each receive an equal amount of overhead. This is because they both have 200 direct labor hours. This means that the mirrors will receive 1/2 of the overhead, or \$25,000. Since they made 25 mirrors, the overhead per mirror is \$1,000.

142 b – Under ABC, the materials handling costs would be allocated based on the number of material moves. Each mirror has 5 material moves and each window has 15. Given that the number of mirrors and windows is the same, we know that the mirrors have 25% of the total material moves. This means that the mirrors should get 25% of the overhead costs, or \$12,500. This is allocated to each of the 25 mirrors at a rate of \$500 per mirror.

143 c – The traditional system will include the costs for direct materials, direct labor and overhead. Direct materials and labor are \$5.15 per unit so all we need to calculate is the overhead per unit. Under the traditional method, overhead is applied based on just one activity base. This problem tells us that the company has been applying its manufacturing overhead on the basis of machine hours; so machine hours is the one activity base the company has been using to apply overhead under the traditional method. The rate is \$60 per machine hour ($\$1,800,000 \text{ budgeted costs} \div 30,000 \text{ hours}$). Each unit requires .016 machine hours ($80 \text{ machine hours required for a batch} \div 5,000 \text{ units in a batch}$). This means that each unit will have \$.96 of overhead applied to it under the traditional method. This gives us a total cost of \$6.11 per unit under the traditional method.

144 d – Under the ABC method we will still have \$5.15 in direct materials and direct labor, but we will need to calculate the overhead again. In ABC, there are 4 calculations we will need to make as part of the overhead allocation. These are below per activity:

- a) Material Handling - \$.12 per part ($\$720,000 \div 6,000,000$) and there are 5 parts per unit. This is \$.60.
- b) Setup Costs - \$420 per setup ($\$315,000 \div 750$). There are 2 setups per batch, for a cost of \$840 for each batch of 5,000 units. This is \$.168 per unit ($\$840 \div 5,000$).
- c) Machining Costs - \$18 per machine hour. There are 80 machine hours per batch, giving us \$1,440 per batch of 5,000 units, or \$.288 per unit.
- d) Quality Control - \$450 per batch. This is \$.09 per unit ($\$450 \div 5,000$).

In total, these costs add up to \$6.30.

145 d – The cost of goods sold includes direct materials (\$13,700), direct labor (\$4,800) and overhead ($\$20,000 = 800 \text{ hours} \times \$25 \text{ per hour}$). In total this is \$38,500. Allocated to the 7,000 units, this is a cost per unit of \$5.50. Administrative and selling costs are not part of the cost of goods sold.

146 d – Under the direct method the service department costs are not allocated to other service departments. When we determine the ratio to allocate the costs to the production departments, we must not include the usage by the other service departments. In order to allocate the costs of the quality control department to assembly, we need to determine what percentage of the quality control time used by the production departments was used by assembly. Assembly used QC 7,000 hours and machining used QC 21,000. Thus, assembly will get 25% (or \$87,500) of the QC costs. Assembly used the maintenance department a total of 12,000 hours and machining used maintenance for 18,000 hours. Thus, assembly will get 40% of the maintenance costs (or \$80,000). In total, therefore, the assembly department received \$167,500 from the service departments.

147 d – Again using the direct method we need to determine how much is allocated to the machining department. We can do this in one of two ways. The first way is the same as the previous question. The second way is to subtract the costs that were allocated to assembly from the total service costs. Total service costs were \$550,000. Since \$167,500 was allocated to assembly, then \$382,500 was allocated to machining. However, we also need to include the machining department's own costs of \$400,000. So, \$782,500 in total costs needs to be allocated to the 50,000 machine hours. This gives a rate of \$15.65 per machine hour ($\$782,500 \div 50,000$).

148 b – In the step-down method we need to first allocate costs from QC, and in this process we will allocate some of its costs to maintenance. In total, QC provided 35,000 hours of service and maintenance used 7,000 of them. So, maintenance will get 20% of the QC costs, or \$70,000. Adding this to the \$200,000 of its own costs, the maintenance department has \$270,000 to allocate. These will be allocated only to the production departments. The assembly department used 40% of the maintenance hours that were used by production departments, so \$108,000 will be allocated to assembly ($\$270,000 \times .4$).

149 d – The reciprocal method requires the usage of two formulas. The two formulas are based on the total costs that each service department incurred and they are:

$$QC = \$350,000 + .25M \quad \text{and} \quad M = \$200,000 + .20QC$$

Now, we can solve this for either variable by substituting one equation into the other. We will solve for QC (because this is what the question asks for), as follows:

$$QC = \$350,000 + .25(\$200,000 + .20QC)$$

$$QC = \$350,000 + \$50,000 + .05QC$$

$$.95QC = \$400,000 \quad \quad \quad \mathbf{QC = \$421,053}$$

This is the amount of costs that the QC department must allocate, including allocation to the maintenance department.

150 c – This is a very simple question, but after the previous four, it seems too easy. We simply need to divide the assembly overhead costs by the number of direct labor hours. $\$300,000 \div 25,000 = \$12$.

151 d – Cost reduction is an important factor in a just-in-time system. JIT inventory systems combine purchasing, production and inventory control into one function to reduce the level of inventory that is held within the company at all stages of production. This, in turn lowers the cost of carrying the inventory.

152 c – A company outsources a particular function or functions to an outside specialist to free up its own resources. This allows the company to focus on its primary operations. It may be cheaper to outsource a function, but the disadvantage can be that the company loses direct control over the function or situation.

153 d – Customer service, production, marketing and sales, and R&D are the primary activities or business functions that add value to a company's product or service. Information systems, infrastructure, human resources, and materials management are activities that support these primary activities as defined in the value chain.

154 c – ISO is based upon the quality of the product being even throughout all units produced, not the quality compared to another company's product.

155 d – This is an internal benchmark because it is comparing different plants within the company, and it is nonfinancial because it is measuring the number of on-time deliveries.

156 a – Determining what processes the company uses to convert materials, capital and labor into value-adding products is not part of benchmarking. Rather, benchmarking measures its products, practices and services against successful competitors, using the competitors' standards as goals for its own operations. This "best practices" process helps the company to cut costs, boost output and achieve competitive advantage. Companies use target costing to set standard costs, which creates the desired profit margin for their products so that that ideal standards can be set to attain desired costs. Target costing utilizes kaizen, or continuous improvement, to reduce costs and attain desired profit margins.

157 a – The company believes that being known as a TQM and CI adherent lead to greater customer satisfaction. The other choices may all result from this, but they are not the reason that this decision was made.

158 d – TQM focuses on enhancing the quality of the product or service with consistency, providing a high level of customer service, eliminating non-value adding work, and responding quickly and flexibly to the shifting requirements of customers. Computer-aided design (CAD) utilizes computers in the product development, analysis and design modification stages.

159 a – As part of TQM all employees are expected to be proactive in their education and self-improvement.

160 c – One of the critical steps in business process reengineering is the identification of the company's distinctive competencies. This enables the organization to identify what it does better than its competitors, and therefore understand what activities are vital to its success.

161 d – By definition, these are internal failure costs.

162 d – The equipment maintenance and product testing are classified as prevention and appraisal costs ($\$1,940 = \$1,154 + \$786$).

163 b – Monitoring is an activity overseen and/or performed at the management level for the purpose of assessing the operation and effectiveness of existing internal controls. A reconciliation performed at the departmental level does not provide information for monitoring the internal control system.

164 a – Segregation of duties requires that the following four functions be done by different people: (1) authorizing a transaction; (2) recording the transaction; (3) keeping physical custody of the related asset; and (4) periodic reconciliation of the physical asset with the recorded amount for the asset. If the individual recording the transaction were to also compare the accounting record of the asset with the asset itself, that person would be performing two of the above functions: recording the transaction and periodic reconciliation of the physical asset with the recorded amount for the asset.

165 d – If the same person is recording cash receipts and also reconciling the bank account, that person could post a cash receipt to a customer's account, divert the cash from the bank deposit, and cover it up by reporting an outstanding deposit or a reconciling item on the bank reconciliation.

166 c – The accounts receivable manager's writing off delinquent accounts is a violation of segregation of duties, because it combines under one person the functions of authorizing a transaction and recording the transaction.

167 b – Both timekeeping and preparation of payroll journal entries should take place outside of the payroll department. As long as a person performing those two functions had no payroll department function, that person could do both timekeeping and prepare journal entries without violating segregation of functional responsibilities.

168 b – If the same person were to prepare both attendance data and the payroll, that person could attribute fictitious work hours to a fictitious employee and then pay that employee, diverting the funds to their own account.

169 d – The Foreign Corrupt Practices Act applies to any individual firm, officer, director, employee or agent of the firm and any stockholder acting on behalf of the firm. Thus, the company as a whole and anyone acting on its behalf is designated the responsibility of devising and maintaining adequate internal control. In the event of a violation, any director, officer, shareholder, or other agent who, acting on behalf of the corporation, willfully violates the FCPA is subject to a fine of up to \$100,000 and a prison term of up to 5 years, or both. A corporation is subject to a fine of up to \$2 million.

170 c – The internal audit function provides a means to monitor the organization's control over operations.

171 b – The internal audit department's responsibilities extend to auditing any operation of the organization where its services are needed. An important part of the audit process is making recommendations for

improvement in controls. Thus, the assignment to audit the telephone marketing operation and recommend procedures and policies for improving management control over the operation is entirely appropriate.

172 d – An internal auditor who is assisting with the external, independent financial audit will be supervised by the external auditor because the internal auditor is a related party to the company and is thus not independent.

173 b – Account balances that are the result of complex calculations are susceptible to inherent risk, because the risk of error is naturally there due to the complexity of the calculation.

174 a – Internal auditors are responsible for monitoring the organization's internal controls that protect the organization's assets and maintain the reliability of financial reporting; and the organization's compliance with internal and external rules and regulations. Statistical sampling techniques are among the tools used by auditors to quantify sampling risk in the process of carrying out their responsibilities, but they are not the auditor's main concern.

175 c – The assessment of audit risk is the assessment of the overall probability that an assertion of management will be materially misstated, and the auditor will miss it. Overall audit risk is the product of three component risks: inherent risk, control risk and detection risk. Inherent risk is the probability that an assertion will be materially misstated if there are no controls in place, and the auditor would miss the misstatement.

176 a – The Personnel Department, a department separate from the Payroll Department, should authorize all payroll changes such as hires, terminations, pay rate changes or job status changes. This fulfills the internal control requirement that one person should authorize a transaction, while a different person records the transaction.

177 b – Part of the planning process for an audit is an evaluation of the organization's internal control structure. The results of this evaluation are used to determine the level of control risk. In turn, the level of control risk assessed determines the level of detection risk required in order to attain an acceptable level of overall audit risk.

178 c – A review of quality control results is not a part of a financial statement audit. It would, however, be an important part of a quality control audit.

179 d – Sales, production and quality control reviews are not relevant to a financial statement audit. However, maintenance of control over unused checks is very relevant in a financial audit, as it addresses a risk of loss that could occur in the event of theft of the checks.

180 b – An audit program is developed to detail the work to be accomplished, how it is to be done and what is to be done. The audit program is developed after a survey of the situation, determination of what the objectives of the audit, description of the controls in place and controls that need to be in place for the objectives to be achieved. The audit program then includes the procedures to be carried out to reach the objectives of the audit. Thus, a standardized audit program would not be adequate for a company with a complex or changing operational environment.

181 b – An audit program needs to be developed individually for each auditing assignment after surveying the specific needs of the area to be audited.

182 d – After completing the on-site survey in which the objectives for the audit are developed, the auditor writes the audit program. The audit program describes the procedures to be carried out to reach the objectives of the audit.

183 c – "Relevant" information is information that is consistent with the audit objectives and supports the audit findings and recommendations. If an audit were being done of the Payroll Department, for example, an examination of accounts payable checks and invoices would not be relevant.

184 d – Competent evidence is reliable and is the best attainable through the use of appropriate audit techniques. Thus, an original signed document would be competent evidence.

185 b – Circumstantial evidence is evidence that is consistent with a particular inference. It indicates only that an assertion could be true. Circumstantial evidence can be used to narrow competing explanations, but it is not persuasive in demonstrating fact. It can only be secondary, or supportive, evidence.

186 b – Information received by interviewing people can be useful, but it should be corroborated by objective evidence.

187 a – An operational audit consists of examining and evaluating systems of internal control, overall company operations, and the quality of performance in carrying out assigned responsibilities, compared with a standard.

188 d – External, independent auditors perform financial audits. Their responsibility is to issue an opinion on the accuracy and fairness of management's assertions regarding the financial statements, and they do not normally evaluate operations and make recommendations to management for improvement. Internal auditors

performing an operational audit, on the other hand, are expected to compare "what is" with "what should be" and report to management their findings, with suggestions and recommendations for improvement.

189 b – An operational audit consists of examining and evaluating systems of internal control, overall operations of an organization, and the quality of performance in carrying out assigned responsibilities. As such, performance statistics on the quality of the delivery of a city's service would be an appropriate subject for an operational audit.

190 d – Purchases made from related parties are a risk factor in a purchasing department, because of the potential for conflict of interest. Competitive bids should be requested from approved vendors for the purchase of large-ticket items. However, there is no requirement that purchases be rotated among suppliers, as long as the suppliers are included on the approved list.

191 b – It is never appropriate for an auditor to perform the duties of personnel in an area being audited.

192 b – Internal auditors performing an operational audit are expected to compare "what is" with "what should be" and report to management their findings, along with suggestions and recommendations for improvement. External, independent auditors are concerned with performing financial audits.

193 a – Due diligence is an engagement to confirm company records, both financial and those of ownership of property, utilized especially when a unit is being acquired, merged or sold.

194 a – Someone who is embezzling from his employer will have access to funds that payroll records do not indicate he should legitimately have. Although a perpetrator of financial fraud may be living a luxurious lifestyle due to having received compensation (i.e., bonuses) above and beyond what he legitimately earned, the compensation will be a matter of record.

195 d – Some of the requirements that top management sets forth for middle management can make the organization susceptible to fraud. For example, unreasonable goals that managers are required to meet in order to keep their jobs may create an environment in which fraudulent reporting will take place. In addition, a member of top management may be tempted to commit fraud if he or she would stand to benefit greatly financially as a result, for example by receiving a substantial bonus.

196 a – The internal auditor's responsibility in a fraud audit is to discover the presence, scope and means of misappropriation of assets or fraudulent reporting. This will include assessing the probable level and extent of complicity in the fraud. The internal auditor's further responsibility is to work cooperatively with all other internal and external parties who are involved in the investigation.

197 d – Audit reports should be issued in a timely manner. This audit report was issued eight weeks after the audit. In addition, the internal auditor should discuss his conclusions and recommendations with management before the final written report is issued. Thus, the management of the store in question should have known about the problem well before they did.

198 a – Part of the internal auditor's responsibilities in following up after an audit include doing follow-up testing after any corrective action has taken place to determine the results of the corrective action. This information becomes a part of the auditor's follow-up report to management.

199 b – Application controls are related to the inputs, files and outputs of an application program.

200 b – Good documentation is essential for installation, operation, and modification of a system.

201 b – State-of-the-art software and hardware are not part of a sound preventive control system.

202 a – Systems analysis consists of organizational analysis to learn about the current system's strengths and weaknesses; identification of users' requirements for the new system; identifying the system requirements to fulfill the information needs of the users; evaluating alternative designs using cost-benefit analysis; and preparing a systems analysis report documenting the design of the proposed system and its specifications.

203 a – The most important segregation in computer systems is between the programmers and the operators.

204 b – Duplicate circuitry, echo check, and dual reading are part of the error correction systems built into hardware to provide the system with fault tolerance.

205 c – Preformatted input screens present a blank field in the format the input should take.

206 c – Edit programs check the validity and accuracy of input data.

207 a – A hash total is a meaningless sum of numbers in a batch, such as the sum of all the employee I.D. numbers. A hash total would detect a substituted employee time card, because the employee I.D. number of the substituted employee would be different from the employee I.D. number of the original employee.

208 d – Hash totals are a method of validating the input of data.

209 d – Computer generated reports can be designed to provide more specific, and sorted, information about the errors.

210 a – A completeness test would not let the processing proceed if the item is not complete.

211 a – Preventive controls are the most cost effective controls.

212 c – Edit tests are an input control. They are used to check whether data has been input correctly. Thus, they should be performed on transaction files before those files are used to update the master file in a posting run, because it is much easier to correct errors before posting has taken place than it is afterwards.

213 a – Not detecting certain viruses is a major risk in relying on antivirus software. This software will work only for known viruses and may not be completely effective for variants of those viruses.

214 a – The objective of security software is to control access to information system resources, such as program libraries, data files and propriety software.

215 b – Encryption would be the most effective control over electronic transmission of data. It may be possible to access the transmission line, but the encryption key would be necessary to understand the data being sent.

216 d – All three should be addressed in an analysis of cost-benefit considerations.

217 d – A hot site is a backup facility with a computer system similar to the one used regularly that is fully operational and immediately available.

218 b – This is a true statement about retention of backup files, but not each day's transaction files. By not retaining each day's transaction files it is possible that the last backup file that was created will be lost.

219 a – It is important that the disaster recovery plan embrace data center recovery, critical application recovery and network recovery. It should be updated and current with regard to recent test results and new applications, equipment and network configurations.